ACADEMIC CURRICULUM
(REGULATION 2022)
FOR

UNDER GRADUATE PROGRAMMES
CHOICE BASED CREDIT SYSTEM
(Applicable to the students admitted from the Academic Year 2023 – 2024 onwards)

B.E – ELECTRONCIS AND COMMUNCIATON ENGINEERING

B.E- ELECTRONICS AND COMMUNICATION ENGINEERING

ABOUT THE DEPARTMENT

The Department of Electronics and Communication Engineering, was established in the year 2008 with an intake of 60, with the intent of raising highly qualified Engineers, Entrepreneurs and Researchers who can make substantial contribution to the field of Electronics and Communication Engineering. The research interests of the faculty members of the department encompass the wide area of applied and fundamental aspects of Electronics and Communication Engineering. It offers innovative approaches for teaching-learning and encourages virtual learning with un-compromised professional ethics.

The undergraduates from this department have become professional engineers, and are employed both in core and software companies. They are well represented at core companies, such as Robert Bosch, Qualcomm, Aricent Group, Wipro R&D and as well as smaller start-up companies. They have become successful Software developers and Managers in the leading software companies, such as Thoughtworks, Infosys, Cognizant Technology Solutions, HCL Technologies, TCS, IGate, etc.

VISION

Cultivating innovative and entrepreneurial Electronics and Communication Engineering graduates to ethically address global challenges through quality teaching and learning practices.

MISSION

Mission 1: To facilitate a state-of-the-art teaching-learning process, imparting comprehensive knowledge in electronics and communication engineering and related interdisciplinary areas.

Mission 2: To foster a sense of curiosity, critical thinking and ethical practices in students, preparing them for a continuous learning.

Mission 3: To instil innovative team work and industry collaboration for enhancing entrepreneurial skills, employability and research capabilities in graduates.

Mission 4: To inculcate ability for delivering novel solutions by taking social and environmental aspects into consideration.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

Bachelor of Electronics and Communication Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

PEO 1: Our graduates will have skills to become successful in academics, industries, or as entrepreneurs.

PEO 2: Our graduates with a research inclination will be solving various complex social issues using advanced tools and technologies.

PEO 3: Our graduates will practice engineering with ethics, human values, and environmental consciousness.

PROGRAMME OUTCOMES (POs)

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Analyse and develop solutions in domains like IOT, Embedded, VLSI and other emerging technologies

PSO 2: Understand and architect wired and wireless analog and digital communication systems and products

B.E ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM FOR SEMESTERS AND SYLLABI FOR SEMESTER I TO VIII
SEMESTER I

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
MANDATORY COURSE										
*	22IP100	Induction Programme	-	-	-	-	-	03 Weeks	0	-
THEORY COURSES										
1		Language Elective I	L+P	3	0	2	0	5	4	HSMC
2	22BST101	Basic Mathematics for Engineers	L	3	1	0	0	4	4	BSC
3	22BST102	Engineering Physics	L	3	0	0	0	3	3	BSC
4	22BST103	Engineering Chemistry	L	3	0	0	0	3	3	BSC
5	22EST101	Problem Solving and Python Programming	L	3	0	0	0	3	3	ESC
6	22HSM101	தமிழர் மரபு/ Heritage of Tamils	L	1	0	0	0	1	1	HSMC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET101	Engineering and Professional Skills	L+P	1	0	2	0	3	2	EEC
PRACTICAL COURSES										
8	22ESP101	Problem Solving and Python Programming Laboratory	P	0	0	4	0	4	2	ESC
9	22BSP101	Physics and Chemistry Laboratory	P	0	0	4	0	4	2	BSC
EMPLOYABILITY ENHANCEMENT COURSE										
10	22EEP101	Product Tinkering Laboratory	P	0	0	2	0	2	1	EEC
			TOTAL	**16**	**1**	**16**	**0**	**33**	**25**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1		Language Elective II	L+P	3	0	2	0	5	4	HSMC
2	22BST203	Transforms and Numerical methods	L+T	3	1	0	0	4	4	BSC
3	22ECT201	Electronic Devices	L	3	0	0	0	3	3	PCC
4	22EST203	Basics of Electrical Engineering and Circuits	L	3	0	0	0	3	3	ESC
5	22EST202	Engineering Graphics	L+P	1	0	4	0	5	3	ESC
6	22HSM201	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	L	1	0	0	0	1	1	HSMC
EMPLOYABILITY ENHANCEMENT COURSE										
7	22EET201	Innovation and Design Thinking*	L	2	0	0	0	2	2	EEC
PRACTICAL COURSES										
8	22ESP201	Engineering Product Laboratory	P	0	0	3	0	3	1.5	ESC
9	22ECP201	Circuits and Devices Laboratory	P	0	0	3	0	3	1.5	PCC
10	22NXP201	NCC/NSS/YRC Credit Course Level – I #	-	1	0	0	0	1	1#	-
			TOTAL	**17**	**1**	**12**	**0**	**30**	**23**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
***Common for all branches**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22BST302	Probability and Random Process	L+T	3	1	0	0	4	4	BSC
2	22ECT301	Electronics Circuits	L	3	0	0	0	3	3	PCC
3	22ECT302	Signals and Systems	L+P	3	0	2	0	5	4	PCC
4	22ECT303	Digital Electronics	L	3	0	0	0	3	3	PCC
5	22HST301	Entrepreneurship and startups*	L	2	0	0	0	2	2	HSMC
MANDATORY COURSE										
6	22EST401	Environmental Sciences and Sustainability	L	2	0	0	0	2	2	ESC
PRACTICAL COURSES										
7	22ECP301	Electronic Circuits Laboratory	P	0	0	3	0	3	1.5	PCC
8	22ECP302	Digital Electronics Laboratory	P	0	0	3	0	3	1.5	PCC
EMPLOYABILITY ENHANCEMENT COURSE										
9	22EEP301	Soft Skills*	P	0	0	2	0	2	1	EEC
			TOTAL	**16**	**1**	**10**	**0**	**27**	**22**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

*** Common to all branches**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22ECT401	Communication Systems	L	3	0	0	0	3	3	PCC
2	22ECT402	Linear Integrated Circuits and Applications	L	3	0	0	0	3	3	PCC
3	22ECT403	Electromagnetic Field Theory	L+T	3	1	0	0	4	4	PCC
4	22ECT404	Control Systems	L	3	0	0	0	3	3	PCC
5	22ECT405	Microcontroller based system design	L+J	3	0	0	2	5	4	PCC
PRACTICAL COURSES										
6	22ECP401	Linear Integrated Circuits Laboratory	P	0	0	3	0	3	1.5	PCC
7	22ECP402	Communication Systems Laboratory	P	0	0	3	0	3	1.5	PCC
8	22NXP401	NCC/NSS/YRC Credit Course Level-II #	-	1	0	0	0	1	1#	-
EMPLOYABILITY ENHANCEMENT COURSE										
9	22EEP401	Quantitative Aptitude and Logical Reasoning – I *	P	0	0	2	0	2	1	EEC
			TOTAL	**16**	**1**	**8**	**2**	**27**	**21**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
*** Common to all branches**
 # NCC Credit Course level II is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22ECT501	VLSI Design	L	3	0	0	0	3	3	PCC
2	22ECT502	Discrete Time Signal Processing	L+P+J	2	0	2	2	6	4	PCC
3	22ECT503	Wireless Communication	L	3	0	0	0	3	3	PCC
PROFESSIONAL ELECTIVE										
4		Professional Elective I	L	3	0	0	0	3	3	PEC
EMPLOYABILITY ENHANCEMENT COURSE										
5	22EET501	Engineering Economics and Financial Management*	L	3	0	0	0	3	3	EEC
MANDATORY COURSE										
6		Mandatory Course - I	L	3	0	0	0	3	0	MCC
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
7		Minor/ Honour/ Remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES										
8	22ECP501	VLSI Laboratory	P	0	0	3	0	3	1.5	PCC
9	22ECP502	Simulation Laboratory	P	0	0	3	0	3	1.5	PCC
EMPLOYABILITY ENHANCEMENT COURSE-										
10	22EEP501	Internship*	P	0	0	0	0	0	1	EEC
			TOTAL	**20**	**00**	**08**	**02**	**30**	**20**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22ECT601	Transmission Lines and RF Systems	L	3	1	0	0	4	4	PCC
2	22ECT602	Embedded Systems and IoT Design	L	3	0	0	0	3	3	PCC
OPEN ELECTIVE										
3		Open Elective-I	L	3	0	0	0	3	3	OEC
PROFESSIONAL ELECTIVE										
4		Professional Elective - II	L	3	0	0	0	3	3	PEC
5		Professional Elective - III	L	3	0	0	0	3	3	PEC
MANDATORY COURSE										
6		Mandatory Course - II	L	3	0	0	0	3	0	MCC
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
7		Minor/Honour/remedial class**		3	0	0	0	3	3**	PEC**
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
8	22EEP601	Quantitative Aptitude and Logical Reasoning – II *	P	0	0	2	0	2	1	EEC
9	22EEP602	Comprehensive Assessment*		0	0	2	0	2	1	EEC
PRACTICAL COURSES										
10	22ECP601	Embedded Systems Laboratory	P	0	0	4	0	4	2	PCC
11	22NXP601	NCC/NSS/YRC Credit Course Level- III #	-	1	0	0	0	1	1#	-
			TOTAL	**22**	**1**	**8**	**0**	**31**	**20**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**
 # NCC Credit Course level III is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
THEORY COURSES										
1	22ECT701	Antennas and Microwave Engineering	L	3	0	0	0	3	3	PCC
OPEN ELECTIVE										
2		Open Elective-II	L	3	0	0	0	3	3	OEC
PROFESSIONAL ELECTIVE										
3		Professional Elective – IV	L	3	0	0	0	3	3	PEC
4		Professional Elective – V	L	3	0	0	0	3	3	PEC
5		Professional Elective – VI	L	3	0	0	0	3	3	PEC
6		Management Elective	L	3	0	0	0	3	3	PEC
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
7		Minor/ Honour/ Remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES										
8	22ECP701	Advanced Communication Laboratory	P	0	0	4	0	4	2	PCC
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
9	22EEP701	Product Design and Development *	J	0	0	0	4	4	2	EEC
10	22EEP702	Internship *	P	0	0	0	0	0	1	EEC
			TOTAL	**21**	**0**	**04**	**04**	**29**	**23**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category
*** Common to all branches**
**** Common to all branches, selection from one minor vertical/approved honors subjects**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	MODE	PERIODS PER WEEK				TCP	C	CAT
				L	T	P	J			
ENROLLMENT FOR B.E. / B.TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)										
1		Minor/Honour/remedial class **	L	3	0	0	0	3	3**	PEC**
PRACTICAL COURSES - EMPLOYABILITY ENHANCEMENT COURSE										
2	22ECJ801	Project Work	J	0	0	0	16	16	08	EEC
			TOTAL	**03**	**00**	**00**	**16**	**19**	**8**	

L- Lecture T- Tutorial P- Practical J- Project TCP- Total Contact Periods
C- Credits CAT- Category

**** Common to all branches, selection from one minor vertical/approved honors subjects**

CREDIT DISTRIBUTION

Semester	HSMC	BSC	ESC	PCC	PEC	OEC	EEC	MC	TOTAL	Total PER %
I	5	12	5				3		25	15.43
II	5	4	7.5	4.5			2		23	14.20
III	2	4	2	13			1		22	13.58
IV				20			1		21	12.96
V				13	3		4		20	12.35
VI				9	6	3	2		20	12.35
VII				5	12	3	3		23	14.20
VIII							8		8	4.94
TOTAL	12	20	14.5	64.5	21	6	24		162	100

CATEGORY		Breakup of Credits	PER % in Total
HSMC	Humanities & Social Science Including Management	12	7
BSC	Basic Science Courses	20	12
ESC	Engineering Science Courses	14.5	9
PCC	Professional Core Courses	64.5	40
PEC	Professional Elective Courses	21	13
OEC	Open Elective Courses	6	4
EEC	Employment Enhancement Courses	24	15
MCC	Mandatory Courses		0
	Total Credits	162	100

PROFESSIONAL ELECTIVES COURSES: VERTICALS

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V	VERTICAL VI
Semiconductor Chip Design and Testing	**Signal Processing**	**RF Technologies**	**Bio Medical Technologies**	**Sensor Technologies and IoT**	**High Speed Communications**
Wide Bandgap Devices	Advanced Digital Signal Processing	RF Transceivers	Wearable Devices	IoT Processors	Optical Communication & Networks
Validation and Testing Technology	Image Processing	Electromagnetics for Communication	Human Assist Devices	IoT Based System Design	Wireless Broad Band Networks
Low Power IC Design	Speech Processing	Antenna Design	Therapeutic Equipment	Wireless Sensor Network and Design	Software Defined Networks
VLSI Testing and Design For Testability	Software Defined Radio	MICs and RF System Design	Medical Imaging Systems	Industrial IoT and Industry 4.0	Massive MIMO Networks
Mixed Signal IC Design Testing	DSP Architecture and Programming	EMI/EMC Pre Compliance Testing	Brain Computer Interface and Applications	Network Security	Advanced Wireless Communication Techniques
Analog IC Design	Computer Vision	RF ID System Design and Testing	Body Area Networks	Fundamentals of Cloud Computing	4G/ 5G Communication Networks

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulation.

VERTICAL I Semiconductor Chip Design and Testing								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ECE001	Wide Bandgap Devices	2	0	2	0	4	3
2	22ECE002	Validation and Testing Technology	2	0	2	0	4	3
3	22ECE003	Low Power IC Design	2	0	2	0	4	3
4	22ECE004	VLSI Testing and Design For Testability	3	0	0	0	3	3
5	22ECE005	Mixed Signal IC Design Testing	2	0	2	0	4	3
6	22ECE006	Analog IC Design	2	0	2	0	4	3

VERTICAL II Signal Processing								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ECE007	Advanced Digital Signal Processing	2	0	2	0	4	3
2	22ECE008	Image Processing	3	0	0	0	3	3
3	22ECE009	Speech Processing	2	0	2	0	4	3
4	22ECE010	Software Defined Radio	2	0	2	0	4	3
5	22ECE011	DSP Architecture and Programming	2	0	2	0	4	3
6	22ADE006	Computer Vision	2	0	2	0	4	3

VERTICAL III RF Technologies								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ECE013	RF Transceivers	2	0	2	0	4	3
2	22ECE014	Electromagnetics for Communication	3	0	0	0	3	3
3	22ECE015	Antenna Design	2	0	2	0	4	3
4	22ECE016	MICs and RF System Design	2	0	2	0	4	3
5	22ECE017	EMI/EMC Pre Compliance Testing	2	0	2	0	4	3
6	22ECE018	RF ID System Design and Testing	2	0	2	0	4	3

VERTICAL IV Bio Medical Technologies								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22BME032	Wearable Devices	3	0	0	0	3	3
2	22BME039	Human Assist Devices	3	0	0	0	3	3
3	22ECE019	Therapeutic Equipment	3	0	0	0	3	3
4	22BME028	Medical Imaging Systems	3	0	0	0	3	3
5	22BME029	Brain Computer Interface and Applications	3	0	0	0	3	3
6	22BME034	Body Area Networks	3	0	3	0	3	3

VERTICAL V Sensor Technologies and IoT								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ECE020	IoT Processors	2	0	2	0	4	3
2	22ECE021	IoT Based System Design	3	0	0	0	3	3
3	22ECE022	Wireless Sensor Network and Design	3	0	0	0	3	3
4	22ECE023	Industrial IoT and Industry 4.0	2	0	2	0	4	3
5	22ECE024	Network Security	3	0	0	0	3	3
6	22ECE025	Fundamentals of Cloud Computing	3	0	0	0	3	3

VERTICAL VI High Speed Communications								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22ECE026	Optical Communication & Networks	3	0	0	0	3	3
2	22ECE027	Wireless Broad Band Networks	3	0	0	0	3	3
3	22ECE028	Software Defined Networks	2	0	2	0	4	3
4	22ECE029	Massive MIMO Networks	2	0	2	0	4	3
5	22ECE030	Advanced Wireless Communication Techniques	3	0	0	0	3	3
6	22ECE031	4G/ 5G Communication Networks	2	0	2	0	4	3

ELECTIVE – MANAGEMENT (Semester VII)								
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22EMT001	Principles of Management	3	0	0	0	3	3
2	22EMT002	Total Quality Management	3	0	0	0	3	3
3	22EMT003	Engineering Economics and Financial Accounting	3	0	0	0	3	3
4	22EMT004	Human Resource Management	3	0	0	0	3	3
5	22EMT005	Knowledge Management	3	0	0	0	3	3
6	22EMT006	Industrial Management	3	0	0	0	3	3

MANDATORY COURSE I								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22MCT001	Introduction to Women and Gender Studies	3	0	0	0	3	0
2	22 MCT002	Elements of Literature	3	0	0	0	3	0
3	22 MCT003	Film Appreciation	3	0	0	0	3	0
4	22MCT004	Well Being with Traditional Practices (Yoga, Ayurveda and Siddha)	3	0	0	0	3	0
5	22MCT005	Indian Constitution	3	0	0	0	3	0
6	22MCT006	Industrial Safety	3	0	0	0	3	0

MANDATORY COURSE II								
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22 MCT007	Ethics and Values	3	0	0	0	3	0
2	22 MCT008	History of Science and Technology in India	3	0	0	0	3	0
3	22MCT009	Political and Economic Thought for a Humane Society	3	0	0	0	3	0
4	22MCT010	State, Nation Building and Politics in India	3	0	0	0	3	0
5	22MCT011	Disaster Management	3	0	0	0	3	0

LANGUAGE ELECTIVE (SEMESTER II)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22LET101	Japanese Language Level I	3	0	2	0	5	4
2	22LET102	French Language Level I	3	0	2	0	5	4
3	22LET103	German Language Level I	3	0	2	0	5	4
4	22HST101	Professional English	3	0	2	0	5	4

LANGUAGE ELECTIVE (SEMESTER II)								
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**J**	**Contact Hours**	**Credits**
1	22LET201	Functional English	3	0	2	0	5	4
2	22LET202	French Language Level II	3	0	2	0	5	4
3	22LET203	German Language Level II	3	0	2	0	5	4
4	22LET205	Japanese Language Level II	3	0	2	0	5	4

SEMESTER I

Course Code	Course Title	L	T	P	J	C
22BST101	BASIC MATHEMATICS FOR ENGINEERS	3	1	0	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To develop the use of matrix algebra techniques that are needed by engineers for practical applications.
2. To acquaint the students with differential calculus.
3. To explain the student with functions of several variables.
4. To make the students understand various techniques of integration and its applications.
5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE OUTCOME:

After completion of this course, the students should be able to

1. Use the matrix algebra methods for solving practical problems.
2. Apply differential calculus tools in solving various application problems.
3. Able to use differential calculus ideas on several variable functions.
4. Apply different methods of integration in solving practical problems.
5. Apply multiple integral ideas in solving areas, volumes and other practical problems.

UNIT-1	MATRICES	9+3 HOURS

Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT-2	DIFFERENTIAL CALCULUS	9+3 HOURS

Representation of functions - Limit of a function- Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Logarithmic differentiation - Maxima and Minima of functions of one variable.

UNIT-3	FUNCTIONS OF SEVERAL VARIABLES	9+3 HOURS

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT-4	INTEGRAL CALCULUS	9+3 HOURS

Definite and Indefinite integrals - Substitution rule - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction

UNIT-5	MULTIPLE INTEGRALS	9+3 HOURS

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids	
TOTAL LECTURE AND TUTORIAL HOURS:	**45+15 HOURS**
TEXT BOOK(S):	
1.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons,10th Edition, New Delhi, 2016.
2.	Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition , 2018.
3.	James Stewart, “Calculus: Early Transcendentals”, Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].
REFERENCE BOOKS:	
1.	Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016
2.	Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3.	Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4.	Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	Srimantha Pal and Bhunia. S.C, “Engineering Mathematics" Oxford University Press, 2015.
7.	Thomas. G. B., Hass. J, and Weir. M.D, " Thomas Calculus", 14th Edition, Pearson India, 2018.

Course Code	Course Title	L	T	P	J	C
22BST102	ENGINEERING PHYSICS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To make the students effectively achieve an understanding of mechanics.
2. To enable the students to gain knowledge of electromagnetic waves and its applications.
3. To introduce the basics of oscillations, optics and lasers.
4. Equipping the students to successfully understand the importance of quantum physics.
5. To motivate the students towards the applications of quantum mechanics.

COURSE OUTCOME:

After completion of this course, the students should be able to

CO1: Understand the importance of mechanics.

CO2: Express their knowledge in electromagnetic waves.

CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Understand the importance of quantum physics.

CO5: Comprehend and apply quantum mechanical principles towards the formation of energy bands

UNIT I	MECHANICS	9 hours

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - MI of a diatomic molecule - theorems of MI – moment of inertia of continuous bodies –- torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule.

UNIT II	ELECTROMAGNETIC WAVES	9 hours

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure – basic introduction to Satellite Communication (qualitative treatment)

UNIT III	OSCILLATIONS, OPTICS AND LASERS	9 hours

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave -– interference–Michelson interferometer – Theory of laser – characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV	BASIC QUANTUM MECHANICS	9 hours

Photons and light waves - Electrons and matter waves – Photoelectric effect - The Schrodinger equation (Time dependent and time independent forms) - interpretation of wave function_–Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization and probabilities – Bohr's correspondence principle (concept only).

UNIT V	APPLIED QUANTUM MECHANICS	9 hours

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunnelling (qualitative)- Tunnelling microscope - Resonant diode – Principle of quantum superposition – concept of quantum entanglement – concepts of quantum communication and quantum teleportation

Total Lecture hours:	**45 hours**

Text Book(s)

1.	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2.	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3.	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.

Reference Books

1.	R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2.	Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3.	K. Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4.	D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5.	N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer Verlag, 2012.

Course Code	Course Title	L	T	P	J	C
		3	**0**	**0**	**0**	**3**
22BST103	**ENGINEERING CHEMISTRY**	Syllabus version		v. 1.0		

COURSE OBJECTIVES:

1. To inculcate a sound understanding of water quality parameters and water treatment techniques.
2. To impart knowledge on the basic principles and preparatory methods of nanomaterials.
3. To introduce the different polymers and composites for engineering applications.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of storage devices and computational chemistry that are essential for chemistry.

COURSE OUTCOME:

1. To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
2. To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
3. To analyse the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness and composites for material selection requirements.
4. To recommend suitable fuels for engineering processes and applications.
5. To solve chemical problems by simulating chemical systems (molecular, biological, materials) in order to provide reliable, accurate and comprehensive information at an atomic level.

Unit-1	**WATER AND ITS TREATMENT**	**9 HOURS**

Water: Sources and impurities, Requirements of potable water, Desalination of brackish water: Reverse Osmosis. Requirements of water for industrial use, Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment -Ion exchange demineralization and zeolite process. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination).		
Unit-2	**NANOCHEMISTRY**	**9 HOURS**
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
Unit-3	**POLYMERS AND COMPOSITES**	**9 HOURS**
Definition of biodegradable polymers- Classification of biodegradable Polymers – Advantages, conducting polymers-polyaniline, polyacetylene, recycling of e-plastic waste (waste to wealth). Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer, matrix, metal matrix and ceramic matrix) and Reinforcement (fibre, particulates, flakes and whiskers). Properties and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		
Unit-4	**FUELS AND COMBUSTION**	**9 HOURS**
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Synthetic Petrol (Bergius Process) and Diesel, Knocking - octane number, diesel oil-cetane number; Power alcohol and biodiesel. Combustion of fuels: Calorific value - higher and lower calorific values, Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.		
Unit-5	**COMPUTATIONAL CHEMISTRY AND STORAGE DEVICES**	**9 HOURS**
Computational chemistry-molecular dynamics and chemical reactivity. Cheminformatics and Green IOT in biomedical applications, Artificial intelligence and machine learning methods to predict physicochemical properties. Batteries: a brief introduction to electrochemical cell (Daniel cell), Types of batteries, Primary battery, Secondary battery - lead acid battery and lithium-ion- battery; battery used in Electric vehicles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
	Total Lecture hours:	45 hours
Text Book(s)		
1.	P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.	
2.	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.	
3.	S.S. Dara, “A Text book of Engineering Chemistry”, S. Chand Publishing, 12th	

	Edition.
Reference Books	
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Textbook of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2.	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3.	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4.	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

Course Code	Course Title	L	T	P	J	C
22EST101	PROBLEM SOLVING AND PYTHON PROGRAMMING	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

COURSE OUTCOME:

After completion of this course, the students should be able to

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs using conditionals and loops for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

UNIT-1	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9 HOURS

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT-2	DATA TYPES, EXPRESSIONS, STATEMENTS	9 HOURS

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT-3	**CONTROL FLOW, FUNCTIONS, STRINGS**	**9 HOURS**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT-4	**LISTS, TUPLES, DICTIONARIES**	**9 HOURS**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT-5	**FILES, MODULES, PACKAGES**	**9 HOURS**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S):		
1.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.	
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017	
REFERENCE BOOKS:		
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition,2021.	
2.	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.	
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021	
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.	
5.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.	

Course Code	Course Title	L	T	P	J	C
22HSM101	HERITAGE OF TAMILS	1	0	0	0	1
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To provide an insight to the students into the rich culture and heritage of the state.
2.To provide the students detailed information on the engineering techniques to construct architectural marvels practiced in Tamil Nadu.
3.To make the students connect with their roots , appreciate and preserve etc.

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Understand the human values and rights in Tamil Nadu Literature.
2.Learn the art and culture being practiced by people of Tamil Nadu.
3.Undertand various games and dance practiced by people of Tamil Nadu.
4.Learn the concepts of sangam Literature and the bravery of kings.
5.Learn life history of freedom fighters Vedic herbs and developments in life style.

UNIT-I	LANGUAGE AND LITERATURE	03 HOURS

Language Families in India - Dravidian Languages – Tamil as a Classical Language - ClassicalLiterature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT-II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	03 HOURS

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT-III	FOLK AND MARTIAL ARTS	03 HOURS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT-IV	THINAI CONCEPT OF TAMILS	03 HOURS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT-V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	03 HOURS

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systemsof Medicine – Inscriptions & Manuscripts – Print History of Tamil Books

TOTAL LECTURE HOURS:	**15 HOURS**

TEXT BOOK(S)	
1.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3.	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
4.	Kanini Tamil- Munaivar L. Sundaram
REFERENCE BOOKS	
1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (inprint)
2.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4.	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K. Pillay) (Published by: The Author)
5.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu TextBook and Educational Services Corporation, Tamil Nadu)

Course Code	Course Title	L	T	P	J	C
22EET101	**ENGINEERING AND PROFESSIONAL SKILLS**	**1**	**0**	**2**	**0**	**2**
		Syllabus Version			**v. 1.0**	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.Understand the characteristics of 'engineering' and the quality engineers have played in shaping engineering up to the present and into the future

2.Understand a range of principles in science, mathematics, and engineering in order to make well-founded decisions as part of a design process

3.To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content

4.To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered

5.To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, present ability, aesthetics, using media elements and enhance the overall quality of presentations

COURSE OUTCOME: After completion of this course, the students should be able to

1.Understand the basic knowledge in evolution of engineering
2.Understand the basic knowledge in Engineering approach
3.Use the MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
4.Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
5.Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

UNIT-I	EVOLUTION OF ENGINEERING	6 HOURS

Evolution of Engineering: Description of Engineering, Early stages of Engineering, Outline of Ancient Engineering, Case studies of historic engineers.
Introduction to Engineering Career: Engineering as a career and common qualities of employable engineers History of Engineering Domains Impact of engineering on society. Roles of Engineers and Career Paths.

UNIT-II	ENGINEERING APPROACH	6 HOURS

Introduction, problem statement: Detailing Customer Requirements, Setting Objectives, Identifying Constraints, Establishing Functions, generating solution Alternatives and Choosing a solution.
Steps in problem-solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. seven steps in solving engineering problems, reverse engineering, forward engineering, concurrent engineering,
and Value Engineering.

UNIT-III	MS WORD	6 HOURS

Create and format a document, Working with tables, Working with Bullets and Lists, Working with styles, shapes, smart art, charts Inserting objects, charts and importing objects from other office tools, Creating and Using document templates, Inserting equations, symbols and special characters, Working with Table of contents and References, citations Insert and review comments, Create bookmarks, hyperlinks, endnotes footnote, Viewing document in different modes, Working with document protection and security, Inspect document for accessibility.

UNIT-IV	MS EXCEL	6 HOURS

Create worksheets, insert and format data, Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data Sort and filter data Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae, Create and Work with different types of charts, Use pivot tables to summarize and analyse data, Perform data analysis using own formulae and functions, Combine data from multiple worksheets using own formulae and built-in functions to generate results, Export data
and sheets to other file formats, Working with macros, Protecting data and Securing the workbook

UNIT-V	MS POWERPOINT	6 HOURS

Hours Select slide templates, layout and themes, Formatting slide content and using bullets and numbering, Insert and format images, smart art, tables, charts Using Slide master, notes and handout master, Working with animation and transitions, Organize and Group slides Import or create and use media objects: audio, video, animation, Perform slideshow recording and Record narration and create presentable videos.

	TOTAL LECTURE HOURS:	30 HOURS

LIST OF EXPERIMENTS

1. Create a Bio – Data by using MS-Word.
2. Create a Time Table by using MS-Word.
3. Create an Agenda by using MS-Word.
4. Create a mail merge by using MS-Word.
5. Create a Piechart by using MS-Word.
6. Paragraph Formatting, Line Spacing And Sorting, Bullets And Numbering
7. Create an Interactive form in MS-Word
8. Create a Resume by using MS-Word templates.
9. Calculate student mark details by using MS-Excel.
10. Create an employee work details list by using MS-Excel.
11. Create two types of charts by using MS-Excel.
12. Create a presentation using MS POWERPOINT.
13. Create an advertisement by using PowerPoint presentation
14. Create an organization chart by using PowerPoint.
15. Create an organization chart for college results by using MS PowerPoint templates.
16. Create an advertisement for TV channel by using Power Point.

TEXT BOOK(S):

1.	Remesh S., Vishnu R. G., Life Skills for Engineers, Ridhima Publications, 1stEdition,2016.
2.	Barun K. Mitra, Personality Development & Soft Skills, Oxford Publishers, Third impression, 2017.
3.	Dorothy House, Microsoft Word, Excel, and PowerPoint: Just for Beginners, Import, 29

REFERENCE BOOKS:

1	Paul H .Wright, Introduction to Engineering, School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc,

Course Code	Course Title	L	T	P	J	C
22ESP101	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	0	0	4	0	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To understand the problem solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.

COURSE OUTCOME:

On completion of the course, students will be able to:

1. Develop algorithmic solutions to simple computational problems
2. Develop and execute simple Python programs.
3. Implement programs in Python using conditionals and loops for solving problems. Deploy functions to decompose a Python program.
4. Process compound data using Python data structures.
5. Utilize Python packages in developing software applications.

LIST OF EXPERIMENTS:

1. Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL LECTURE HOURS:	**60 HOURS**

Course Code	Course Title	L	T	P	J	C
22BSP101	PHYSICS AND CHEMISTRY LABORATORY	0	0	4	0	2
		Syllabus version			v. 1.0	

PHYSICS LABORATORY
(Any Seven Experiments)

COURSE OBJECTIVES:

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student an active participant in each part of all lab exercises.

COURSE OUTCOME:

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyse laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyse scientific information.
5. Solve problems individually and collaboratively.

LIST OF EXPERIMENTS (Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wavelength of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL LECTURE HOURS:	30 HOURS

Course Code	Course Title	L	T	P	J	C
22BSP101	PHYSICS AND CHEMISTRY LABORATORY	0	0	4	0	2
		Syllabus version			v. 1.0	

CHEMISTRY LABORATORY

(Any seven experiments to be conducted)

Course Objectives:

1. To impart practical skills in the estimation of water quality parameters by volumetry and gravimetry.
2. To familiarize the students with the estimation of impurities in aqueous solutions through electro-analytical techniques such as pH metre, potentiometry and conductometry.
3. To demonstrate the analysis of metals by UV-Visible spectroscopy.

Course Outcome:

1. To independently estimate the water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride and copper contents by appropriate wet chemical analyses.
2. To quantitatively analyze the impurities in aqueous solution by electroanalytical techniques.
3. To determine the amount of metal ions in aqueous samples by spectroscopic techniques.

LIST OF EXPERIMENTS: ANY SEVEN

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of TDS of a water sample by gravimetry.
7. Determination of strength of given hydrochloric acid using pH meter.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
10. Estimation of iron content of the given solution using potentiometer.
11. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).

Total Lecture hours:	**30 HOURS**

Course Code	Course Title	L	T	P	J	C
22EEP101	PRODUCT TINKERING LABORATORY	0	0	2	0	1
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Hands on practical training, maintenance and troubleshooting on mechanical and electrical appliances in day-to-day life.
2. Analyse single phase and three phase residential building wiring (Energy meter, fuse, earthing)
3. Understand the internal structure and layout of the computer system.
4. Learn to diagnose minor problems with the computer functioning.
5. Know the proper usage and threats of the world wide web.

COURSE OUTCOME:

1. Students will able to understand domestic wiring procedures practically.
2. Students are capable of assembling a personal computer, and can perform installation of system software like MS Windows and required device drivers.
3. Students can detect and perform minor hardware and software level troubleshooting.
4. Capacity to work on Internet & World Wide Web and make effective usage of the internet for academics.

LIST OF EXPERIMENTS:

1. **MECHANICAL EQUIPMENT STUDY**

(a) Hand drilling machine, Screw Jack and centrifugal pump

(b) Two wheeler, Refrigeration and Air Conditioning system.

2. **ELECTRICAL EQUIPMENT STUDY**

Light fittings, LED, Stabilizer, UPS, Iron box, calling bell, Fan regulator

3. ELECTRONIC EQUIPMENT STUDY

a) Study the elements of a smart phone.

b) Assembly and dismantle of LED TV.

c) Assembly and dismantle of computer/ laptop

4. COMPUTER PERIPHERALS STUDY

PC HARDWARE Identification of the peripherals of a computer, components in a CPU and its functions. Block diagram of the CPU along with the configuration of each peripheral. Functions of Motherboard. Assembling and Disassembling of PC. System Software and application software installation.

5. BIOMEDICAL EQUIPMENT

a) Assembly and dismantle of Electrocardiogram (ECG)

b) Assembly and dismantle of ventilator.

c) Assembly and dismantle of Doppler Ultra sound Scanner.

TROUBLESHOOTING *Hardware Troubleshooting*: Students are to be given a PC which does not boot due to proper assembly or defective peripherals and the students should be taught to identify and correct the problem. *Software Troubleshooting*: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. *Internet:* Web Browsers, Access of websites, Surfing the Web, Search Engines, Customization of web browsers, proxy settings, bookmarks, search toolbars, pop-up blockers. Antivirus downloads, Protection from various threats.

TOTAL LECTURE HOURS:	**30 HOURS**

LANGUAGE ELECTIVE I

Course Code	Course Title	L	T	P	J	C
22LET101	**JAPANESE LANGUAGE LEVEL I**	**3**	**0**	**2**	**0**	**4**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To train the students to learn basic Japanese including three writing systems
2. To teach them to learn basic grammar and vocabulary
3. To train them to converse in Japanese in day-to-day scenarios.

COURSE OUTCOME:

Upon completion of the course, the student will be able to

CO1: Acquire familiarity in all 3 Japanese alphabet & basic vocabulary (Understand) CO2: Listen and identify individual sounds of Japanese (Understand)

CO3: Use basic sounds and words while speaking (Apply)

CO4: Read and understand simple advertisements, brochures and invitations (Apply)

CO5: Use basic grammar and appropriate vocabulary in completing language tasks (Apply)

UNIT-1	INTRODUCTION TO JAPANESE	9 HOURS

Japanese written system - Japanese sounds - Hiragana (あ、い、う、え、お…) -Hiragana variations - Katakana - Katakana variations-Exchange greetings - Recognise Japanese characters.

UNIT-2	MYSELF	9 HOURS

Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa…desu - mo particle- to particle - ni particle - no particle.

UNIT-3	FOOD	9 HOURS
Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.		
UNIT-4	**HOME**	**9 HOURS**
Home - Furniture - 4 kanjis - Places to visit nearby - Rooms - Things in the room - ni + ga + arimasu- ni + ga + imasu - general counter - My home - My room		
UNIT-5	**DAILY LIFE**	**9 HOURS**
Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara… made… - time expression - ii adjective.		
	Total Lecture hours:	**45 hours**

TEXT BOOK(S)

1.	独立行政法人国際交流基金, **来嶋**, **柴原** & 八田. Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Competences / まるごと 日本のことばと文化 入門 A1 **りかい** 2023.

REFERENCE BOOKS

1.	Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
2.	Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
3.	www.japaneselifestyle.com
4.	www.learn-japanese.info/
5.	www.kanjisite.com/ & www.learn-hiragana-katakana.com/typing-hiragana-characters/

LIST OF EXPERIMENTS :

1. Give a simple self introduction
2. Tell someone about your family, using a family photo
3. Talk about your favorite foods
4. Offer someone a drink
5. Talk about your breakfast
6. Say what your favorite dish is
7. Order food and drinks at a hamburger shop
8. Say what kind of home you live in

9. Say what you have in your home
10. Write an E-mail inviting someone to your home
11. Talk about your daily routine
12. Write a birthday card

Course Code	Course Title	L	T	P	J	C
22LET102	FRENCH LANGUAGE LEVEL I	3	0	2	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To acquire an understanding of basic French language parts of speech
2. To facilitate learner's ability to learn the French language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

COURSE OUTCOME:

1. Read and write technical basic French language parts of speech
2. Speak appropriately learner's ability to learn the French language grammar.
3. Listen and comprehend lectures learner's ability to understand the sentence structure
4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
5. Prepare self-introduction comprehend various lectures and talks

UNIT-1	INTRODUCTION TO THE FRENCH LANGUAGE	(9+6) Hours

Découvrir la langue française - Identifier la langue - Les lettres de l'alpahbet - Se presenter, presenter quelqu'un - Les nationalités - Les nombres 0-60

UNIT-2	GRAMMAR OF COMMUNICATION	(9+6) Hours

Les articles définis et indéfinis - Les prépositions des pays - Les verbes – 1er groupe - Les verbes irréguliers- être, avoir, aller, venir, faire, vouloir, pouvoir, devoir, savoir, prendre - Les adjectifs interrogatifs - Les adjectifs possessifs - Les articles contractés - Les prépositions de lieu

- Les verbes pronominaux - Le pronom « on »

UNIT-3	SENTENCE STRUCTURE	(9+6) Hours

Raconter et reporter-donner son avis - Futur simple, pronomcomplètementd'objet direct, passé compose - plusieursrégion de France, imparfait, pronom y/en, imparfait

UNIT-4	ACTIVE AND COMMUNICATIVE ASPECTS	(9+6) Hours
- Proposing a party/ visit a place - Inviting/accepting an invitation/refusing an invitation - Exprimerl'accord/désaccord (to express an agreement / disagreement) - Rapporter les paroles (reported speech) - Organiser/faire un projet de sortie (to organize/ to do a trip)		
UNIT-5	**FRENCH CULTURE AND CIVILISATION**	**(9+6) Hours**
- Les familles françaises - Presentation of a city and its monuments - Introduction to the geography of France - Festivals and events of France - The French school calendar + les horairesfrançaises - Les reseauxsociaux - Les villesen France		
	Total Lecture hours:	45 hours

TEXT BOOK(S)	
1.	Méthode de français A1, Jacky Girardet et al, CLE International
2.	Christine Andantétal "À propos (livre de l'élève", LANGER., NEW DELHI,2012
REFERENCE BOOKS	
1.	Michael D. Oates "Entre Amis: An Interactive Approach", 5 th Edition, Houghton Mifflin., 2005
2.	Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French"
3.	Simone Renaud, Dominique van Hooff "En bonne forme

Course Code	Course Title	L	T	P	J	C
22LET103	GERMAN LANGUAGE LEVEL I	3	0	2	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To train the students to learn basic German
2. To teach them to learn basic grammar and vocabulary.
3. To train them to converse in German in day-to-day scenarios

COURSE OUTCOME:

After the course, the students will be able to:

1.help students acquire familiarity in the German alphabet & basic vocabulary
2.listen and identify individual sounds of German
3.use basic sounds and words while speaking

UNIT-1	INTRODUCTION TO GERMANY AND ITS REGIONS –GERMAN BASIC PHRASES, ALPHABETS, NUMBERS, COUNTRIES AND NATIONALITY	(9+6) Hours

Grammaire – Verbs – sein, haben, definite and indefinite articles
Communication – Greetings, Self-Introduction

UNIT-2	BASIC VOCABULARY, COLOURS, MONTHS AND DAYS	(9+6) Hours

Grammaire - Verbes - Conjugation: Present tense (regular verbs) – Adjective possessive
Communication – Talk about family and friends, date, time etc

UNIT-3	HOBBIES, INTERESTS AND DAILY ROUTINE	(9+6) Hours

Grammaire – Irregular verbs
Communication – Talking about hobbies and interests.

UNIT-4	VOCABULARY OF PLACES AND TRANSPORT	(9+6) Hours

Grammaire – Cases, adjective demonstrative, past tense, propositions
Communication – Narrating an incident or story

UNIT-5	VOCABULARY OF FOOD, SERVICES, MONEY	(9+6) Hours

Grammaire – Negation, Verbs – kaufen, essen, bezahlen
Communication – Accept andrefuse an invitation, situation in a restaurant

	TOTAL LECTURE HOURS:	60 HOURS

TEXT BOOK(S)

1.	Mit ErfogZum Goethe-Zertifikat A1

REFERENCE BOOKS

1.	Studio d - Deutsch alsFremdsprache - Grundstufe - A1
2.	Fit Fur Goethe-Zertifikat A1 (Start Deutsch 1)
SOFTWARE	
1.	All internet tools

Course Code	Course Title	L	T	P	J	C
22HST101	PROFESSIONAL ENGLISH	3	0	2	0	4
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Provide learners with basic vocabulary and grammar to recognize and use in real time Contexts
2. Improve communicative competence
3. Help use the language effectively in academic /work contexts
4. Build language skills by engaging in listening, speaking, vocabulary and grammar learning activities relevant to authentic contexts
5. Develop the ability to read and write complex texts, summaries, articles, blogs, definitions, essays, and user manuals

COURSE OUTCOME:

After the completion of this course, the students should be able to

1. Become accustomed to the basic vocabulary and grammar
2. Listen and comprehend complex academic texts
3. Read and infer the denotative and connotative meanings of technical texts
4. Write definitions, descriptions, narrations, and essays on various topics
5. Speak fluently and accurately in formal and informal communicative contexts

UNIT-1	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	9 HOURS

Reading – Newspaper- sports/health; technical Brochures
Writing – Professional emails; Formal letters
Grammar – Word formation, Parts of speech, Framing questions
Vocabulary – Synonyms and Antonyms, One-word substitution, Abbreviations and Acronyms

UNIT-2	NARRATION AND SUMMATION	9 HOURS

Reading – Biographies/ Travelogues
Writing - Guided writing- Paragraph; Short Report on an event (field trip etc.)
Grammar – Tenses; Subject-Verb Agreement; Prepositions
Vocabulary – Narrative vocabulary; Phrasal verbs

UNIT-3	DESCRIPTION OF A PROCESS / PRODUCT	9 HOURS

Reading – Gadget reviews; Advertisements
Writing - Product description, Process description; Instruction writing
Grammar – Imperatives; Degrees of comparison
Vocabulary – Compound words; Homonyms, homophones; discourse markers- Connectives and

Sequence words		
UNIT-4	**CLASSIFICATION AND RECOMMENDATIONS**	**9 HOURS**
Reading – Newspaper articles; journal reports Writing – Note-making; Interpretation of charts; Recommendations Grammar – Articles; Modal verbs Vocabulary - Collocations; Fixed / Semi fixed expressions.		
UNIT-5	**EXPRESSION**	**9 HOURS**
Reading – Editorials; opinion blogs Writing – Reports – Accident & Survey; Business letters Grammar – Punctuation; Negations; Simple, Complex and Compound sentences Vocabulary - Cause & Effect Expressions; Content vs Function words		
TOTAL HOURS:		**45 HOURS**
TEXT BOOK(S):		
1.	Hewings, Martin Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition	
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.	
REFERENCE BOOKS:		
1.	Ian wood, Anne Williams with Anna Cowper, “Pass Cambridge BEC Preliminary”, 2nd edition, Cengage Learning, 2015.	
2.	Technical Communication – Principles And Practices, Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.	
3.	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd	
4.	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.	
LIST OF EXPERIMENTS:		
1. Listening to introductions of successful people		
2. Self-Introduction and introducing a friend		
3. Listening and filling out a form		
4. Narrating a story using hints		
5. Listening to telephone conversation		
6. Telephonic Interview- Role play		
7. Listening to podcasts, anecdotes/event narration		
8. Narrating personal experiences/ events		
9. Listening to celebrity interviews		
10. Conversation Skills- Politeness strategies		
11. Listening to process descriptions		
12. Describing a process		
13. Listening to travelogues		
14. Narrating travel experiences		
15. Listening to educational videos		
16. Group discussion		
17. Listening to TED Talks		

18. Mini Presentations
19. Listening to description of art work
20. Picture description
21. Listening to scientific lectures
23. Listening to definitions/ descriptions of objects
24. One-minute speech - Describing an object
26. Anchoring a reality show
27. Listening to advertisements
28. Adzap
29. Listening to autobiography
30. Visume
TOTAL HOURS: 45 HOURS

SEMESTER II

Course Code	Course Title	L	T	P	J	C
22BST203	**TRANSFORMS AND NUMERICAL METHODS**	**3**	**1**	**0**	**0**	**4**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.

3. To acquaint the student with Z transform techniques used in wide variety of situations.
4. To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

COURSE OUTCOME:

Upon completion of the course, the students should be able to

1. Apply the concept of testing of hypothesis for small and large samples in real life problems.
2. Apply the basic concepts of classifications of design of experiments in the field of agriculture.
3. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems
4. Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5. Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

UNIT-1	**FOURIER SERIES**	**9+3 HOURS**

Dirichlet's conditions — General Fourier series — Odd and even functions — Half range sine series — Half range cosine series — Parseval's identity — Harmonic analysis.

UNIT-2	**FOURIER TRANSFORMS**	**9+3 HOURS**

Fourier transform pair — Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem – Parseval's identity.

UNIT-3	**Z — TRANSFORMS**	**9+3 HOURS**

Z-transforms — Elementary properties — Inverse Z-transform (using partial fraction and residues)— Convolution theorem.

UNIT-4	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**9+3 HOURS**

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT-5	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 HOURS**

Taylor's series method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order differential equations - Milne's forth predictor corrector methods for solving first order differential equations.

Total Lecture hours:	**60 HOURS**

TEXT BOOK(S)	
1.	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Grewal B.S., “Higher Engineering Mathematics”, 43rd Edition, Khanna Publishers, New Delhi, 2014.
3	Narayanan S., Manicavachagom Pillay.T. K and Ramanaiah.G “Advanced Mathematics for Engineering Students”, Vol. II & III, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
REFERENCE BOOKS	
1.	Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2.	Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4.	Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5.	Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
6.	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

Course Code	Course Title	L	T	P	J	C
22ECT201	ELECTRONIC DEVICES	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To make the students understand the fundamentals of electronic devices.
2. To acquaint the semiconductor properties and formation of PN Junction diode and its characteristics
3. To explain the operation and applications of BJT and FET
4. To study the operation of special diodes and examine their characteristics
5. To describe the functionality of power semiconductor devices and classify various types of optoelectronic devices

COURSE OUTCOME:

Upon completion of the course, the students should be able to

1. Understand the basics of electron devices
2. Explain the basics of device physics and working principle of PN Junction diode
3. Describe the construction, operation and applications of BJT, JFET and MOSFET
4. Understand the device physics of metal-semiconductor junctions and working principle of special semiconductor devices
5. Explain the construction and working principle of power semiconductor devices and optoelectronic and display devices

UNIT-1	**PN JUNCTION DIODE**	**9 HOURS**

Theory of PN junction diode – Energy band structure of open-circuited PN junction – Quantitative theory of PN diode currents – Diode current equation– Static and dynamic resistance levels – Transition and diffusion capacitances, Temperature dependence of V-I characteristics of diode – Switching characteristics, Breakdown in PN junction diodes – Diode as a circuit element – Piecewise Linear diode model – PN diode applications

UNIT-2	**BIPOLAR JUNCTION TRANSISTOR**	**9 HOURS**

BJT: Construction of BJT – Transistor biasing – Operation of NPN and PNP transistors–Types of configurations– Transistor as an amplifier - Large signal, dc and small signal CE values of current gain –Breakdown in transistors – Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi Emitter Transistor.

UNIT-3	**FIELD EFFECT TRANSISTOR**	**9 HOURS**

Construction and operation of N-channel JFET – Characteristic parameters of JFET– Expression for saturation drain current – Slope of V-I characteristics – Biasing for zero current drift - Comparison of BJT and JFET – Applications of JFET, Construction and operation of N Channel and P-Channel MOSFET – Enhancement and depletion type MOSFET – Characteristics – Threshold voltage – Channel length modulation – Comparison of N-channel and P- channel MOSFETs–Comparison of MOSFET with JFET –Applications of MOSFETs in CMOS circuits.

UNIT-4	**SPECIAL SEMICONDUCTOR DEVICES**	**9 HOURS**

Construction, Principle of operation, characteristics and applications of Zener diode, Varactor diode – Metal-Semiconductor junction – Schottky diode – Tunnel diode – Gunn Diode – IMPATT Diode – PIN Diode – PIN Photodiode - Avalanche Photodiode - DUAL GATE MOSFET – FINFET– MESFET.

UNIT-5	**POWER SEMICONDUCTOR AND OPTOELECTRONIC DEVICES**	**9 HOURS**

Power Semiconductor Devices: Construction, Principle of operation, characteristics and applications of UJT, PNPN Diode, SCR, LASER, DIAC, TRIAC, GTO Thyristors – Power BJT – Power MOSFET – DMOS – VMOS. Optoelectronic Devices: Photoconductive sensors – Photoconductive cell – Photovoltaic sensors – Photo emissive sensors –Light emitters - LCD, Alpha numeric displays, LCD Panels, Plasma display Panels - Optocoupler, CCD, BBD.	
Total Lecture hours:	**45 HOURS**
TEXT BOOK(S)	
1.	Donald A Neaman, Semiconductor Physics and Devices, McGraw Hill, Fourth Edition, 2017.
2.	Salivahanan S and Sureshkumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.
REFERENCE BOOKS	
1.	Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, Eleventh Edition, 2013.
2.	Thomas L. Floyd, Electronic Devices, Pearson, Ninth Edition, 2016.
3.	Jacob Millman, Christos C. Halkias and SatyabrataJit, Electronic Devices and Circuits, McGraw Hill, Fourth Edition, 2015.

Course Code	Course Title	L	T	P	J	C
22EST203	**BASICS OF ELECTRICAL ENGINEERING AND CIRCUITS**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To develop an understanding of the fundamental laws, theorems, elements of electric circuits and to analyze dc and ac circuits
2. To understand transient response behavior of electric circuits.
3. To introduce different methods of circuit analysis using network theorems, duality and topology

COURSE OUTCOME:

Upon completion of the course, the students should be able to

1. Design, understand and evaluate the AC and DC circuits
2. Apply the circuit theorems in real time
3. Analyse resonance and coupled circuits
4. Analyse the transient response for DC circuits
5. Explain the two port networks and parameters

UNIT-1	**FUNDAMENTALS OF ELECTRICAL ENGINEERING**	**9 hours**

Fundamental concepts of dc and ac circuits, Steady state solution of DC circuits, Circuit laws and their applications in solving problems Introduction to AC Circuits, Sinusoidal steady state analysis, Power and Power factor, Single phase and three phase balanced circuits.

UNIT-2	**NETWORK THEOREMS FOR DC AND AC CIRCUITS**	**9 hours**

Source transformation, Superposition theorem, Thevenin's & Norton's theorems, Reciprocity and Maximum power transfer theorem, Application of Network theorems - Network reduction: voltage and current division, source transformation – star delta conversion.

UNIT-3	**RESONANCE AND COUPLED CIRCUITS**	**9 hours**

Resonance - Series resonance - Parallel resonance, Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency, Bandwidth - Q factor – Selectivity, Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi winding coupled circuits, Series, parallel connection of coupled inductors - Single tuned and double tuned coupled circuits

UNIT-4	**TRANSIENT ANALYSIS**	**9 hours**

Natural response - Forced response Transient response of RC, RL and RLC circuits to excitation by step signal, impulse signal and exponential sources Complete response of RC, RL and RLC circuits to sinusoidal excitation.

UNIT-5	**TWO PORT NETWORKS**	**9 hours**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) parameters Interconnection of two port networks.

Total Lecture hours:	**45 hours**

TEXT BOOK(S)

1.	Charles K. Alexander, Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 2017, Sixth Edition, Tata McGraw Hill Education Private Limited, India.
2.	Abhijit Chakrabarti, Circuit Theory Analysis and Synthesis, 2018, Seventh Edition, Dhanpat Rai and Co.

REFERENCE BOOKS

1.	Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

2.	Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, 5th Edition, McGraw Hill, 9th Reprint, 2015.
3.	Allan H.Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice”, Cengage Learning, 5th Edition, 1st Indian Reprint, 2013.

Course Code	Course Title	L	T	P	J	C
22EST202	ENGINEERING GRAPHICS	1	0	4	0	3
		Syllabus version	v. 1.0			

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To develop students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing National standards related to technical drawings.
3. To Familiarize with basic geometrical constructions and orthographic projections.
4. To make the students to draw the different projections of the solids.
5. To view the true shape and apparent shape of the sectioned solids and their developments.
6. To get an idea about 3D views through isometric projections.

COURSE OUTCOME:

Upon completion of the course, the students should be able to

1. Perform basic geometrical constructions and principles of orthographic projections.
2. Project orthographic projections of lines and plane surfaces.
3. Draw projections of solids and development of surfaces.
4. Visualize and to project isometric views and conversion of Isometric views to Orthographic views.
5. Understand the basics of AUTO CAD and fundamentals of perspective projections.

UNIT-0	**CONCEPTS AND CONVENTIONS (Not for Examination)**	**3+9 HOURS**

Importance of graphics in engineering applications — Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT-1	**PLANE CURVES,**	**3+9 HOURS**

Conic Sections - Construction of Ellipse, Parabola & hyperbola by eccentricity method – Construction of cycloid. Introduction of Orthographic projection - free hand sketch.
First angle projection - projection of points and Projection of Lines (only for understanding)

UNIT-2	**PROJECTION OF PLANES AND SOLIDS**	**3+9 HOURS**

Projection of simple planes (Square, circular, Hexagon, Pentagon) inclined to both the principal planes by rotating object method. Projection of simple solids like Prism, Pyramid, Cylinder& Cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT-3	**SECTION OF SOLIDS AND DEVELOPMENT SURFACES**	**3+9 HOURS**

Sectioning of simple solids (Prism, Pyramid, Cylinder& Cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of surfaces of right regular sectioned solids		
UNIT-4	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS**	**3+9 HOURS**
Principles of Isometric Projections-Isometric scale- Isometric Views of simple and truncated solids. Conversion of Isometric views of the objects to Orthographic views Exercises using free hand sketching.		
UNIT-5	**COMPUTER AIDED DRAFTING (Only for Internal Evaluation)**	**3+9 HOURS**
Introduction to engineering graphics CAD tools, Drawing Orthographic views from Isometric views using CAD tools--Floor plans of simple buildings- Exercise of circuit diagram (2D Orthographic Views) and 3D modeling (Isometric Views) using AutoCAD Software.		
Special points applicable to University Examinations on Engineering Graphics: 1. There will be five questions, each of either or type covering all units of the syllabus. 2. All questions will carry equal marks of 20 each making a total of 100. 3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size. 4. The examination will be conducted in appropriate sessions on the same day.		
	TOTAL LECTURE HOURS:	**60 HOURS**

TEXT BOOK(S):

1.	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2.	Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.
3.	Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, Oxford University Press, 2015

REFERENCE BOOKS:

1.	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, McGraw Hill, 2nd Edit ion, 2019.
2.	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3.	Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4.	Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.

5.	Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson Education India, 2nd Edition, 2009.
6.	Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.

Course Code	Course Title	L	T	P	J	C
22HSM201	TAMILS AND TECHNOLOGY	1	0	0	0	1
		Syllabus version		v. 1.0		

COURSE OBJECTIVES: After studying this course, you should be able to:

1.Understand the art of making things and developments in the lifestyle of people.
2.Understand the various methods of constructing methods.
3.Understand the techniques being used in architecture by Tamils.
4.Understand and apply the concepts of Tamil with modern technology.

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Know the gradual improvement in the life history of Tamils.
2.Construct buildings with the impact of past with the present.
3.Learn to Manufacture remarkable things with the help of technology.
4.Apply the ancient skills to find out the measurements of oceans.
5.Apply the concepts of Tamil with modern technology.

UNIT-I	WEAVING AND CERAMIC TECHNOLOGY	03 HOURS

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries(BRW) – Graffiti on Potteries.

UNIT-II	DESIGN AND CONSTRUCTION TECHNOLOGY	03 HOURS

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)-
Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT-III	MANUFACTURING TECHNOLOGY	03 HOURS

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem
stone types described in Silappathikaram.

UNIT-IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	03 HOURS

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific
Society.

UNIT-V	SCIENTIFIC TAMIL & TAMIL COMPUTING	03 HOURS

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.	
TOTAL LECTURE HOURS:	**15 HOURS**
TEXT BOOK(S)	
1.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
2.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,
3.	Tamilaga Varalaru, Makalum Panpadum- Dr. K.K. Pillai
REFERENCE BOOKS	
1.	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (inprint)
2.	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3.	Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

Course Code	Course Title	L	T	P	J	C
22EET201	INNOVATIONS AND DESIGN THINKING	2	0	0	0	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Learn design thinking concepts and principles
2. Use design thinking methods in every stage of the problem
3. Learn the different phases of design thinking
4. Apply various methods in design thinking to different problems

COURSE OUTCOME:

Upon completion of the course, the students should be able to

1. Innovation of the new environmental conditions
2. Define key concepts of design thinking
3. Practice design thinking in all stages of problem-solving
4. Apply design thinking approach to real-world problems

UNIT-1	INNOVATIONS	6 HOURS

Introduction, innovation in current environment, types of innovation, schools of innovation, analyzing the current business scenario, challenges of innovation, steps of innovation management, experimentation in innovation management, participation for innovation, co-creation for innovation, prototyping to incubation. blue ocean strategy –I, blue ocean strategy-II. marketing of innovation, technology innovation process.

UNIT-2	DESIGN THINKING	6 HOURS
Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment, System Thinking, Product Thinking.		
UNIT-3	**UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM**	**6 HOURS**
Search field determination - Problem clarification - Understanding of the problem - Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.		
UNIT-4	**IDEATION AND PROTOTYPING**	**6 HOURS**
Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.		
UNIT-5	**TESTING AND IMPLEMENTATION**	**6 HOURS**
Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking. Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing tomorrow.		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Christian Mueller-Rotenberg, Handbook of Design Thinking - Tips & Tools for how to design thinking.
2.	Designing for Growth: a design thinking tool kit for managers by Jeanne Liedtka and Tim Ogilvie.
3.	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown.
4.	John. R. Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage Learning (International edition) Second Edition, 2013

Reference Books

1.	Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
2.	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3.	HassoPlattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2014.

4.	Yousef Haik and Tamer M.Shahin, “Engineering Design Process”, Cengage Learning, Second Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	J	C
22NXP201	NCC Credit Course Level 1*(ARMY WING)	1	0	0	0	1
		Syllabus version			v. 1.0	

UNIT-I	NCC GENERAL	3 HOURS
NCC 1 Aims, Objectives & Organization of NCCNCC 2 Incentives NCC 3 Duties of NCC Cadet NCC 4 NCC Camps: Types & Conduct		
UNIT-II	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**
NI 1 National Integration: Importance & Necessity NI 2 Factors Affecting National Integration NI 3 Unity in Diversity & Role of NCC in Nation Building NI 4 Threats to National Security		
UNIT-III	**PERSONALITY DEVELOPMENT**	**3 HOURS**
PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem SolvingPD 2 Communication Skills PD 3 Group Discussion: Stress & Emotions		
UNIT-IV	**LEADERSHIP**	**2 HOURS**
L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour CodeL 2 Case Studies: Shivaji, Jhasi Ki Rani		
UNIT-V	**SOCIAL SERVICE AND COMMUNITY DEVELOPMENT**	**4 HOURS**
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o YouthSS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel SafetySS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL LECTURE HOURS	**15 HOURS**

Course Code	Course Title	L	T	P	J	C
22ESP201	ENGINEERING PRODUCT LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

After studying this course, you should be able to:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work

5 Making a tray out of metal sheet using sheet metal work.

6. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

COURSE OUTCOME: At the end of the course, the student will be able to

At the end of the course, the student will be able to

1. Able to Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work
2. Able to make various electrical wiring joints in common household electrical wire work.
3. Able to Weld various joints in steel plates using arc welding work;
4. Able to Make a tray out of metal sheet using sheet metal work.
5. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

b) Preparing plumbing line sketches.

c) Laying pipe connection to the suction side of a pump

d) Laying pipe connection to the delivery side of a pump.

e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

PART II ELECTRICAL ENGINEERING PRACTICES

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets

b) Staircase wiring

c) Fluorescent Lamp wiring with introduction to CFL and LED types.

d) Energy meter wiring and related calculations/ calibration

e) Residential house wiring using fuse, switch, indicator, lamp and energy meter Diac/Triac/quadrac)

g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL ENGINEERING)

PART III MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

SHEET METAL WORK:

Making of a square tray, cylinder, prism

DEMO of 3D Printing, Smithy, Foundry

MACHINING – XTurning, drilling

PART IV ELECTRONIC ENGINEERING PRACTICES

a) Soldering simple electronic circuits and checking continuity
b) Printed circuit board making, soldering of electronic components,
c) Fabrication of equipment using of Simple drive systems-electrical/mechanical/pneumatic.
d) Fabrication of equipment using different types of sensors Piezo Electric Sensor, LVDT, Thermistors, Moisture sensor, LDR, Optical Encoders, Pneumatic Position Sensors, Range Sensors, Laser Range Meters, Proximity Sensors, Touch Sensors.
e) Fabrication of equipment using Arduino and Microcontrollers.
f) Fabrication of IoT based equipment

Total Laboratory hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22ECP201	**CIRCUITS AND DEVICES LABORATORY**	**0**	**0**	**3**	**0**	**1.5**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To gain hands- on experience in Thevenin & Norton theorem, KVL & KCL, and Superposition Theorems.
2. To understand the working of RL, RC and RLC circuits
3. To learn the characteristics of PN Junction diode and Zener diode

COURSE OUTCOME:

At the end of the course, the student will be able to

1. Design RL and RC circuits.
2. Verify Thevinin & Norton theorem KVL & KCL, and Super Position Theorems.
3. Characteristics of PN Junction Diode and Zener diode.

LIST OF EXPERIMENTS:

1. Verifications of KVL & KCL. 2. Verifications of Thevenin & Norton theorem. 3. Verification of Superposition Theorem. 4. Verification of maximum power transfer Theorem 5. Determination of Resonance Frequency of Series & Parallel RLC Circuits. 6. Characteristics of PN Junction Diode and Zener diode. 7. Study of series voltage regulator 8. Common Emitter Input – Output Characteristics. 9. Common Base Input – Output Characteristics. 10. FET characteristics – Drain and Transfer Characteristics

TOTAL LABORATORY HOURS:	**45 HOURS**

LANGUAGE ELECTIVE II

Course Code	Course Title	L	T	P	J	C
22LET201	**FUNCTIONAL ENGLISH**	**3**	**0**	**2**	**0**	**4**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Gain confidence to respond in English in both academic and professional contexts
2. Improve presentation skills to make effective presentations
3. Foster the ability to write effectively in all contexts
4. Strengthen the skills related to teamwork and leadership roles in society as well as in workplace

COURSE OUTCOME:

1. To communicate fluently in professional situations
2. To express flexibility and appropriacy on Technical Events
3. To demonstrate complex forms and sentence structures with adequate vocabulary
4. To report events and the processes of technological & Industrial firms.
5. To present effective Profile in context of job search

UNIT-1	**COMMUNICATIVE COMPETENCE**	**9 HOURS**

Speaking – Interactive skills- Initiation & turn taking, relevance to the topic, puzzles & riddles
Reading – Skimming, Scanning, Churning & Assimilation
Writing – Blog Writing, Formal letters -Thanking & Apology
Grammar – Order of Adjectives, Verbs Types
Vocabulary – Morphemes, Phonetics – Vowels & Diphthongs

UNIT-2	**SITUATIONAL CONVERSATIONS**	**9 HOURS**

Speaking – Practicing fluency- cohesion, coherence and speed of delivery **Reading** – Reading brochures and user manuals **Writing** – Checklist, Dialogue Writing **Grammar** – Infinitives, Gerunds, Participles **Vocabulary** – Phonetics- Consonants, Idioms		
Unit-3	**REPORT ON TECHNICAL EVENTS**	**9 hours**
Speaking –Mock TV news Reading/ anchoring **Reading** – Motivational essays on famous Engineers and Technologists **Writing** – Report Writing- Feasibility & Project Report, Project proposals **Grammar** – Reported Speech, Active, Passive and Impersonal Passive Voice **Vocabulary** – Technical Vocabulary, Jargons		
Unit-4	**DEVELOPING DISCUSSION SKILLS**	**9 hours**
Speaking – Giving short talks on technical topics **Reading** - Descriptive passages - newspapers / magazines/ articles **Writing** – Essay Writing: Opinion Essay, Problem solution, Compare & Contrast Essay, Jumbled Sentences **Grammar** – Indirect questions, Conjunctions **Vocabulary** – Single sentence Definition, Purpose Statements,		
Unit-5	**PRESENTATION SKILLS**	**9 hours**
Speaking – Presentations - visual aids- Visume using appropriate body language and gestures, stating, and asking for opinions and clarifications **Reading** – Predicting the content, speed reading techniques **Writing** – Job Application- Cover Letter & Resume, Minutes of Meeting **Grammar** – Mixed Tenses, Clauses **Vocabulary** – Error Spotting, Sentence Completion		
TOTAL LECTURE HOURS:		**45 HOURS**
List of Experiments:		
1. Initiation and turn taking		
2. Writing opinion paragraph		
3. Situational conversations		
4. Writing Checklists		
5. Mock TV news reading		
6. Writing the project proposal and report		
7. Short talk on technical topics		
8. Writing Recommendations		
9. Book/Movie Review		
10. Profile writing		
TOTAL PRACTICAL HOURS:		**30 HOURS**

Text Book(s)	
1.	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University
2.	Functional English for Communication (2022 edition) Ujjwala Kakarla, Guru Nanak Institutions Technical Campus (Autonomous), Hyderabad.
Reference Books	
1.	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2.	Hewings, Martin. Advanced Grammar In Use. New Delhi: CUP,2008 MLA Handbook for Writers of Research Papers, 7th Edition
3.	Klaus Bruhn Jensen. A handbook of Media and Communication Research. Routledge, 2003

Course Code	Course Title	L	T	P	J	C
22LET202	FRENCH LEVEL II	3	0	2	0	4
		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire an understanding of basic French language parts of speech
2. To facilitate learner's ability to learn the French language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

Course Outcome:

1. Read and write technical basic French language parts of speech
2. Speak appropriately learner's ability to learn the French language grammar.
3. Listen and comprehend lectures learner's ability to understand the sentence structure
4. Write correctly, clearly and concisely technical writing skills through tenses and numbers
5. Prepare self-introduction comprehend various lectures and talks

Unit-1	LES ASPECTS ACTIONNELS ET COMMUNICATIFS	(9+6) Hours

• Proposing a party/ visit a place
• Inviting/accepting an invitation/refusing an invitation
• Exprimer l'accord/dés accord (to express an agreement / disagreement)
• Rapporter les paroles (reported speech)
• Organiser/faire un projet de sortie (to organize/ to do a trip)

Unit-2	LA GRAMMAIRE DE LA COMMUNICATION	(9+6) Hours
- Le futur proche – Impératif - Les Articles partitifs - Les expressions de la quantité - Les verbes irréguliers - savoir, vouloir, pouvoir, devoir, partir, dormir - Expression de l'appartenance - Donner une explication		
Unit-3	**LANGUAGE AND COMMUNICATION**	**(9+6) Hours**
- To create a simple travel plan (itinerary) - To use a map and reach a particular destination - Different types of lodging - Meubles et objets de la maison- vocabulary related to the objects of a household. - Expressions des nécessités - Donner des instructions - Une fiche de réservation – filling up a reservation form - To express a problem- exprimer un problème		
Unit-4	**CULTURAL AND CIVILISATIONAL ASPECTS**	**(9+6) Hours**
- Les Français et le logement - Les loisirs et les sorties en France - Les sorties des jeunes - Déjeuner en France - La nourriture		
Unit-5	**PASSAGE D'ÉCRITURE**	**(9+6) Hours**
1. Faites une invitation à votre ami (un mariage/un anniversaire/ passer le weekend/ une sortie) 2. Acceptez/ Refusez l'invitation 3. Ecrivez une carte postale 4. Faites le plan de Paris avec les monuments importants 5. Rédiger un emploi du temps 6. Décrire un itinéraire		
	Total Lecture hours:	**60 hours**

Text Book(s)

1.	Méthode de français A1, Jacky Girardet et al, CLE International
2.	"Littérature Progressive du français »-Niveau intermédiaire (2e Édition)-Nicole Blondeau, Ferroudja Allouache, Marie-Françoise Né.

Reference Books

1.	Michael D. Oates "Entre Amis: An Interactive Approach", 5 th Edition, Houghton Mifflin., 2005
2.	Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French"
3.	Simone Renaud, Dominique van Hooff "En bonne forme

Course Code	Course Title	L	T	P	J	C
22LET203	GERMAN LANGUAGE LEVEL II	3	0	2	0	4
		Syllabus version			v. 1.0	

Course Objectives:

1. To acquire an understanding of basic German language parts of speech
2. To facilitate learner's ability to learn the German language grammar.
3. To nurture learner's ability to understand the sentence structure
4. To foster technical writing skills through tenses and numbers
5. To comprehend various lectures and talks

Course Outcome:

1. Equip the students in greeting forms to greet the person in the first encounter
2. Develop and use familiar, everyday expressions and very simple sentences, which relate to the satisfying of concrete needs.
3. Introduce him/her self and others as well as ask others about themselves – e.g. where they live, who they know and what they own – and can respond to questions of this nature
4. Make use of familiarizing with the days of the week, months, and dates
5. Evaluate the basics of German grammar and practice it in the real time situations

Unit-1	MODULE I	13 hours
Alphabet, Pronunciation (vowels, consonants), Verb conjugation and Personal Pronouns, Greetings, Introduce oneself and others, Numbers up to 20		
Unit-2	**MODULE II**	**13 hours**
Interrogative sentence, Yes or No Questions, The verb 'haben' (to have) and 'sein' (to be)- Definite Articles "der, das, die", Nouns (singular, plural), Week days and Months, Jobs, Hobbies		
Unit-3	**MODULE III**	**09 hours**
Indefinite Articles „ein, ein, eine", - Negation, Imperative with ‚Sie", Strong verbs		
Unit-4	**MODULE IV**	**11 hours**
Verbs with Accusative, Food and Life in Germany, Conversations on Shopping		
Unit V	**MODULE V**	**14 hours**
Time, Adverb of time, Possessive Pronouns, Modal verbs, Separable Verbs, Prepositions, Personal Pronouns in accusative, Past tense of "haben" and "sein", Conversations in a Restaurant, To write an Invitation Letter / E-mail		
	Total Lecture hours:	**60 hours**

Reference Books

1.	Lernziel Deutsch I – Deutsch als Fremdsprache. Max Hueber Verlag, München.
2.	Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2011
3.	Themen Aktuell 1, Hartmurt Aufderstrasse, Heiko Bock, Mechthild Gerdes, Jutta Müller

Course Code	Course Title	L	T	P	J	C

22LET205	JAPANESE LEVEL II	3	0	2	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

4. To train the students to learn basic Japanese including three writing systems
5. To teach them to learn basic grammar and vocabulary
6. To train them to converse in Japanese in day-to-day scenarios.

COURSE OUTCOME:

Upon completion of the course, the student will be able to

CO1: Acquire familiarity in all 3 Japanese alphabet & basic vocabulary (Understand) CO2: Listen and identify individual sounds of Japanese (Understand)

CO3: Use basic sounds and words while speaking (Apply)

CO4: Read and understand simple advertisements, brochures and invitations (Apply)

CO5: Use basic grammar and appropriate vocabulary in completing language tasks (Apply)

UNIT-1	HOLIDAYS	9 HOURS

Hobbies (sports. films, music, etc.) - Places - 18 kanjis - Events - Calendar - ga particle – dekimasu - de particle - masen ka - Shall we go together?

UNIT-2	TOWNS	9 HOURS

Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa…desu - mo particle- to particle - ni particle - no particle.

UNIT-3	SHOPPING	9 HOURS

Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.

UNIT-4	TRAVEL	9 HOURS

Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch.

UNIT-5	JLPT PREPARATION	9

Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara… made… - time expression - ii adjective.

	Total Lecture hours:	45 hours

TEXT BOOK(S)

1.	独立行政法人国際交流基金，来嶋，柴原 & 八田. Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Competences / まるごと 日本のことばと文化 入門 A1 りかい 2023.
REFERENCE BOOKS	
1.	Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
2.	Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers, and Distributors Pvt. Ltd., Delhi, 2007.
3.	www.japaneselifestyle.com
4.	www.learn-japanese.info/
5.	www.kanjisite.com/ & www.learn-hiragana-katakana.com/typing-hiragana-characters/

LIST OF EXPERIMENTS :
1. Talk about what you want to buy
2. Talk about where to shop for something you want
3. Say briefly what you thought about your days off
4. Write a short blog about your days off
5. Say what you did on your travels
6. Say where you want to go next time
7. Talk about where to shop for something you want
8. Say briefly what you thought about your days off
9. Write a short blog about your days off
10. Say what you did on your travels
11. Say where you want to go next time
12. Presentation about your favourite city

SEMESTER III

Course Code	Course Title	L	T	P	J	C
22BST302	PROBABILITY AND RANDOM PROCESSES	3	1	0	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
2. To understand the basic concepts of probability, one- and two-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
3. To understand the basic concepts of random processes which are widely used in IT fields.
4. To understand the concept of correlation and spectral densities.
5. To understand the significance of linear systems with random inputs.

COURSE OUTCOME:

1. Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
2. Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.
3. Apply the concept random processes in engineering disciplines.
4. Understand and apply the concept of correlation and spectral densities.
5. The students will have an exposure of various distribution functions and help in acquiring skills

in handling situations involving more than one variable. Able to analyse the response of random inputs to linear time invariant systems.		
Unit-1	**PROBABILITY AND RANDOM VARIABLES**	**12 hours**
Probability – Axioms of probability – Conditional probability – Baye ‘s theorem – Discrete and continuous random variables – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		
Unit-2	**TWO – DIMENSIONAL RANDOM VARIABLES**	**12 hours**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables		
Unit-3	**RANDOM PROCESSES**	**12 hours**
Classification – Stationary process – Markov process – Markov chain – Poisson process		
Unit-4	**CORRELATION AND SPECTRAL DENSITIES**	**12 hours**
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density- Properties		
Unit-5	**LINEAR SYSTEMS WITH RANDOM INPUTS**	12 hours
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.		
	Total Lecture hours:	60 hours
Text Book(s)		
1.	Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007	
2.	Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.	
Reference Books		
1.	Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012	
2.	Hwei Hsu, "Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.	
3.	Miller. S.L. and Childers. D.G., —Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.	
4.	Stark. H. and Woods. J.W., —Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.	
5.	Yates. R.D. and Goodman. D.J., —Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.	

Course Code	Course Title	L	T	P	J	C
22EST401	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	2	0	0	0	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To study the nature and facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
5. To study the dynamic processes and understand the features of the earth‟s interior and surface.
6. To study the integrated themes and biodiversity, natural resources, pollution control and waste management

COURSE OUTCOME:

1. Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
2. Public awareness of environmental is at infant stage.
3. Ignorance and incomplete knowledge has lead to misconceptions
4. Development and improvement in std. of living has lead to serious environmental disasters

UNIT-1	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY	6 HOURS

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT-2	ENVIRONMENTAL POLLUTION	6 HOURS

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT-3	NATURAL RESOURCES	6 HOURS

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.		
UNIT-4	**SOCIAL ISSUES AND THE ENVIRONMENT**	**6 HOURS**
Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.		
UNIT-5	**HUMAN POPULATION AND THE ENVIRONMENT**	**6 HOURS**
Population growth, variation among nations – population explosion – family welfare Programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.		
	TOTAL LECTURE HOURS:	**30HOURS**

TEXT BOOK(S)	
1.	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006
3.	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,Pearson Education, 2004.
REFERENCE BOOKS	
1.	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi,2007.
2.	Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015
3.	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

Course Code	Course Title	L	T	P	J	C
22ECT301	**ELECTRONICS CIRCUITS**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To understand the operation, design and Analysis of low and high frequency amplifiers.
2. To analyze feedback amplifiers.
3. To analyze and design the frequency of oscillators.

4. To explain the operation of power amplifiers.
5. To understand the analysis of tuned circuits and its stability.

COURSE OUTCOME:

1. Apply the knowledge of BJT to design practical amplifier circuits.
2. Design a feedback amplifiers and power amplifiers to meet the required specifications.
3. Understand the operation of oscillator circuit.
4. Analyze multi vibrators using transistors.
5. Analyze the application of tuned amplifiers.

UNIT-1	**BIASING AND SMALL SIGNAL ANALYSIS OF AMPLIFIERS**	**9 HOURS**

DC Load line, Operating point, Various Biasing Methods for BJT-Design and Stability factors - Bias Compensation, Thermal Stability, Small signal Analysis of Common Emitter amplifiers. Cascaded stages - Cascode Amplifier.

UNIT-2	**HIGH FREQUENCY ANALYSIS AND POWER AMPLIFIERS**	**9 HOURS**

Miller effect, High frequency Analysis of CE Amplifier. Short Circuit Current gain, Cut off frequency – fβ, fT Determination of Bandwidth of Single Stage and Multistage Amplifiers. Large Signal Amplifiers- Class A, Class B, Class AB, Class C.

UNIT-3	**FEEDBACK AMPLIFIERS**	**9 HOURS**

Concept of feedback Amplifiers, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, Voltage series, voltage shunt, Current series and current shunt Feedback configurations.

UNIT-4	**OSCILLATORS**	**9 HOURS**

Conditions for oscillations, Frequency and Amplitude Stability of Oscillators, Generalized analysis of LC Oscillators, Quartz, Hartley, Colpitts, RC–phase shift and Wein Bridge oscillators.

UNIT-5	**TUNED AMPLIFIERS**	**9 HOURS**

Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier – Stagger tuned amplifiers – Stability of tuned amplifiers – Neutralization – Hazeltine neutralization method

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	David A. Bell, “Electronic Devices and Circuits”, Fifth Edition, Oxford University Press, 2008.
2.	Robert L Boylestead and Louis Nashelsky, “Electronic Devices and circuit theory”, Pearson, Tenth edition 2009.

REFERENCE BOOKS	
1.	Millman J, Halkias.C.andSathyabradaJit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
2.	Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4th Edition, , Mc Graw Hill Education (India) Private Ltd., 2017.
3.	Millman and Halkias. C., Integrated Electronics, TMH, 2007.

Course Code	Course Title	L	T	P	J	C
22ECT302	SIGNALS AND SYSTEMS	3	0	2	0	4
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To understand the basic properties of signal & systems
2. To know the methods of characterization of LTI systems in time domain
3. To analyze continuous time signals and system in the Fourier and Laplace domain
4. To analyze discrete time signals and system in the Fourier and Z transform domain

COURSE OUTCOME:

1. Determine if a given system is linear/causal/stable
2. Determine the frequency components present in a deterministic signal.
3. Characterize continuous LTI systems in the time domain and frequency domain
4. Characterize discrete LTI systems in the time domain and frequency domain
5. Compute the output of an LTI system in the time and frequency domains

UNIT-1	CLASSIFICATION OF SIGNALS AND SYSTEMS	9 HOURS

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & aperiodic signals, Deterministic & Random signals, Energy & Power signals -Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT-2	ANALYSIS OF CONTINUOUS TIME SIGNALS	9 HOURS

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT-3	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	9 HOURS

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT-4	ANALYSIS OF DISCRETE TIME SIGNALS	9 HOURS
Sampling and Quantization, Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties.		
UNIT-5	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS**	**9 HOURS**
Impulse response–Difference equations -Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.		
	TOTAL LECTURE HOURS:	**45 HOURS**

PRACTICAL EXERCISES:

MATLAB / EQUIVALENT SOFTWARE PACKAGE.

1. Generation of elementary Discrete-Time sequences.
2. Time and Amplitude transformations: Write a MATLAB program to perform amplitude-scaling, time-scaling and time shifting on a given signal.
3. Fourier Series:

a. To calculate Fourier series coefficients associated with Square Wave.
b. To Sum the first 10 terms and plot the Fourier series as a function of time.
c. To Sum the first 50 terms and plot the Fourier series as a function of time.

4. Calculating transforms using MATLAB

a. Calculate and plot Fourier transform of a given signal.
b. Calculate and plot Z-transform of a given signal.

5. Autocorrelation and Cross-correlation

a. Write a MATLAB program to compute autocorrelation of a sequence x(n) and verify the property.
b. Write a MATLAB program to compute cross-correlation of sequences x(n) and y(n) and verify the property.

TOTAL PRACTICAL HOURS:30 HOURS

TOTAL HOURS :75 HOURS

TEXT BOOKS:	
1.	Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2.	Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002
Reference Books:	
1.	B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford, 2009.
2.	M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018.
3.	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

Course Code	Course Title	L	T	P	J	C
22ECT303	DIGITAL ELECTRONICS	3	0	0	0	3
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1. To present the fundamentals of digital circuits and simplification methods
2. To practice the design of various combinational digital circuits using logic gates
3. To bring out the analysis and design procedures for synchronous and asynchronous sequential circuits
4. To learn integrated circuit families.
5. To introduce semiconductor memories and related technology

COURSE OUTCOME:

1. Use Boolean algebra and simplification procedures relevant to digital logic.
2. Design various combinational digital circuits using logic gates.
3. Analyse and design synchronous sequential circuits.
4. Analyse and design asynchronous sequential circuits.
5. Build logic gates and use programmable device

UNIT-1	**BASIC CONCEPTS**	**9 HOURS**

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions - Karnaugh map, completely and incompletely specified functions, Basic Gates, Implementation of Boolean expressions using universal gates, Tabulation methods.

UNIT-2	**COMBINATIONAL LOGIC CIRCUITS**	**9 HOURS**

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/ Demux

UNIT-3	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 HOURS**

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Moore/Mealy models, state minimization, state assignment, Counters-Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT-4	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 HOURS**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits

UNIT-5	**PROGRAMMABLE LOGIC DEVICES**	**9 HOURS**

Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM, PROM, EPROM, EEPROM, EAPROM

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2.	Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
REFERENCE BOOKS	
1.	Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2.	S.Salivahanan and S.Arivazhagan “Digital Electronics”, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
3.	Soumitra Kumar Mandal “Digital Electronics”, McGraw Hill Education Private Limited,2016.

Course Code	Course Title	L	T	P	J	C
22HST301	ENTREPRENEURSHIP AND STARTUPS	2	0	0	0	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To provide practical, proven tools for transforming an idea into a product or service that creates value for others
2. To build a winning strategy, how to shape a unique value proposition, prepare a business plan
3. To impart practical knowledge on business opportunities
4. To inculcate the habit of becoming an entrepreneur
5. To know the financing, growth, and new venture & its problems

COURSE OUTCOME:

1. Transform ideas into real products, services, and processes by validating the idea, testing it, and turning it into a growing, profitable, and sustainable business.
2. Identify the major steps and requirements to estimate the potential of an innovative idea as the basis of an innovative project.
3. Reach creative solutions via an iteration of a virtually endless stream of world-changing ideas and strategies, integrating feedback and learning from failures along the way.
4. Apply the ten entrepreneurial tools in creating a business plan for a new innovative venture.
5. Apply methods and strategies learned from interviews with start-up entrepreneurs and innovators

UNIT-1	ENTREPRENEURIAL COMPETENCE	9 HOURS

Introduction to Entrepreneurship & Entrepreneur Meaning and concept of Entrepreneurship, the history of Entrepreneurship development, Myths of Entrepreneurship, the role of Entrepreneurship in Economic Development, Agencies in Entrepreneurship Management, and the Future of Entrepreneurship. The Entrepreneur: Means the skills required to be an entrepreneur, the entrepreneurial decision process, Role models, Mentors and Support system.		
UNIT-2	**BUSINESS PLAN PREPARATION AND PROTOTYPING**	**9 HOURS**
Business Opportunity Identification and Preparing a Business Plan Business ideas, methods of generating ideas, and opportunity recognition, Idea Generation Process, Feasibility study, preparing a Business Plan: Meaning and significance of a business plan, components of a business plan. Experimentation and incubation, Participation in Innovation & Co-creation, and Prototyping		
UNIT-3	**ENTREPRENEURIAL ENVIRONMENT**	**9 HOURS**
Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations		
UNIT-4	**LAUNCHING OF SMALL BUSINESS**	**9 HOURS**
Financing & Launching the New Venture Importance of new venture financing, types of ownership, venture capital, types of debt securities, determining ideal debt-equity mix, and financial institutions and banks. Launching the New Venture: Choosing the legal form of the new venture, protection of intellectual property, and formation of the new venture		
UNIT-5	**MANAGEMENT OF SMALL BUSINESS**	**9 HOURS**
Managing Growth & Rewards in New Venture Characteristics of high growth new ventures, strategies for growth, and building the new ventures. Managing Rewards: Exit Strategies for Entrepreneurs, Mergers and acquisitions, Succession and exit strategy, managing failures – bankruptcy - Business Sickness - Effective Management of Small Business - Case Studies		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Stephen Key, “One Simple Idea for Start-ups and Entrepreneurs: Live Your Dreams and Create Your Own Profitable Company”, 1st Edition, Tata Mc Graw hill Company, New Delhi, 2013.	
2.	Charles Bamford and Garry Bruton, “ENTREPRENEURSHIP: The Art, Science, and Process for Success”, 2nd Edition, Tata Mc Graw hill Company, New Delhi, 2016.	
REFERENCE BOOKS		
1.	Philip Auerswald, “The Coming Prosperity: How Entrepreneurs Are Transforming the Global Economy”, Oxford University Press, 2012.	
2.	Janet Kiholm Smith; Richard L. Smith; Richard T. Bliss, “Entrepreneurial Finance: Strategy, Valuation, and Deal Structure, Stanford Economics and Finance”, 2011.	
3.	Edward D. Hess, “Growing an Entrepreneurial Business: Concepts and Cases”, Stanford Business Books, 2011.	

Course Code	Course Title	L	T	P	J	C

22ECP301	ELECTRONIC CIRCUITS LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To learn the Frequency response of CE, CB, CC, CS Amplifier.
2. To understand the Transfer characteristics of differential amplifier.
3. To study the various Oscillator circuits and power amplifiers.

COURSE OUTCOME:

1. Analyse the limitation in bandwidth and single stage and multistage amplifier.
2. Design and Testing of BJT and MOSFET amplifiers.
3. Operation of power amplifiers.

LIST OF EXPERIMENTS:

1. Frequency response of CE and CS amplifiers.
2. Frequency response of CB and CC amplifiers.
3. Frequency response of Cascade Amplifier
4. CMRR measurement of Differential Amplifier
5. Class A Transformer Coupled Power Amplifier
6. Series and Shunt feedback amplifiers - Frequency response, input and output impedance.
7. RC Phase shift oscillator and Wien Bridge Oscillator.
8. Hartley Oscillator and Colpitts Oscillator.
9. Single Tuned Amplifier.

TOTAL LABORATORY HOURS:	45 HOURS

Course Code	Course Title	L	T	P	J	C
22ECP302	DIGITAL ELECTRONICS LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Get practical experience in design, realisation and verification of Demorgan's Theorem
2. Design Full/Parallel Adders and Subtractors
3. Design and learn Multiplexer using logic gates, Demultiplexer and Decoder
4. Verify the function of Flip-Flops
5. Design Shift registers and Counters using Flip flops

COURSE OUTCOME:

1. Justify NAND and NOR as Universal gates and verify SOP and POS expressions using them.
2. Verify De Morgan's Theorem for 2 variables using logic gates.
3. Design, Build and test combinational circuits such as adders, Subtractor, comparators, multiplexers demultiplexers and decoders.
4. Construct flips-flops using NAND gates and verify their functionality.
5. Realize synchronous and asynchronous counters and its applications using flip-flop IC's
6. Construct the types of shift registers using flip-flop IC's and verify their functionality.

LIST OF EXPERIMENTS:

1. To realize Basic gates (AND, OR, NOT) From Universal Gates (NAND & NOR).
2. To verify

(a) Demorgan's Theorem for 2 variables
(b) The sum-of product and product-of-sum expressions using universal gates

3. To design and implement 4-bit Parallel Adder/ Subtractor using IC 7483
4. To realize (a) 4:1 Multiplexer using gates

   (b) 3-variable function using IC 74151(8:1 MUX)
5. To realize (a) 1:8 Demultiplexer and

   (b) 3:8 Decoder using IC74138
6. To design 4 bit comparator circuit using logic gates
7. To realize the following flip-flops using NAND Gates:

(a) Clocked SR Flip-Flop
(b) JK Flip-Flop

8. To realize the following shift registers using Ic7474:

(a) SISO (b) SIPO
(c) PISO (d) PIPO

9. To realize the Ring Counter and Johnson Counter using Ic7476
10. To realize the Mod-N Counter using Ic7490

TOTAL LABORATORY HOURS:	**45 HOURS**

Course Code	Course Title	L	T	P	J	C
22EEP301	**SOFT SKILLS**	**0**	**0**	**2**	**0**	**1**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Do self-introspection and develop right attitude 2. Understand the self-motivation and mange his abilities with time 3. Understand the inter personal skills 4. Know the leader's qualities and develop as a leader 5.Undersating the conflict at work and make right decisions
COURSE OUTCOME:
1. Able to develop self-confidence through right attitude 2. Use self-motivation and to manage his abilities 3. Effectively use inter personal skills 4. Develop leadership qualities 5. Able to make right decisions and solving conflicts

UNIT-1	**SELF ANALYSIS**	**6 HOURS**
Introduction, SWOT analysis, self-introspection, self confidence and self-esteem, Creativity -Out of the box thinking, Creative thinking and Lateral thinking, Factors influencing attitude, Influence of attitude on behaviour, Synergy between knowledge, skill and attitude,		
UNIT-2	**GROWTH FACTORS**	**6 HOURS**
Motivation, Motivational factors, Self-motivation, Intrinsic and extrinsic motivators, Goal setting, SMART goals, Short, long, life time goals, Time management, Value of time, Test your Time management skill, Prioritizing work, Time management matrix		
UNIT-3	**INTERPERSONAL SKILLS**	**6 HOURS**
Gratitude, Secret of happiness, Understanding the integration of leadership, networking and teamwork, situation analysis, Importance of teamwork, Teamwork activity, Stress Management-Causes of stress and its impact, how to manage and de-stress		
UNIT-4	**LEADERSHIP**	**6 HOURS**
Skills needed for a good leader, Types of leadership style, Assessment of leadership skills, Wheel of leadership, Personal, social and professional etiquette Emotional intelligence, Emotional quotient and intelligence quotient, Emotion scale, Managing emotions		
UNIT-5	**CONFLICT RESOLUTION AND DECISION MAKING**	**6 HOURS**
Conflicts in human relations, Self-assessment test for conflict management, Approaches to conflict resolution, Case study **Decision making-** Importance of decision making, Impact of decision in life, Process and practical way of decision making.		
	TOTAL LECTURE HOURS:	**30 HOURS**

TEXT BOOK(S)	
1.	SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications.
REFERENCE BOOKS	
1.	Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
2.	Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
3.	Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972.

4	Daniel Coleman, Emotional Intelligence, Bantam Book, 2006.
5	Carnegie Dale, How to stop worrying and start living, New York: Simon & Schuster, 1985.
6	http://empower.srmuniv.ac.in (online LMS)

SEMESTER – IV

Course Code	Course Title	L	T	P	J	C
22ECT401	COMMUNICATION SYSTEMS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES

1. To introduce Analog Modulation Schemes
2. To understand the concept of narrowband and wide band FM and interpret the effect of noise in FM receiver
3. To impart knowledge of baseband pulse transmission, inter-symbol interference and its compensation methods
4. To study the scheme of passband digital transmission for band limited and wideband signals
5. To study the characteristics of discrete memory less channel and provide the solution for lossless, error free communications

COURSE OUTCOME: At the end of the course, the student will be able to understand the

CO 1: Gain knowledge in amplitude modulation techniques

CO 2: Understand the concepts of FM

CO 3: Gain knowledge in baseband pulse transmission

CO 4: Understand the scheme of passband digital transmission

CO 5: Understand the concepts of information theory and coding techniques.

UNIT-1	**AMPLITUDE MODULATION**	**9 HOURS**

Introduction: Modulation and its need– Linear modulation schemes: DSB, SSB and VSB-power spectrum – SSB Generation – Filter and Phase Shift Methods, VSB Generation – Superheterodyne receivers – Noise in AM receivers: coherent detection, envelope detection.

UNIT-2	**ANGLE MODULATION**	**9 HOURS**

Frequency modulation, Narrowband FM, Wideband FM – Generation of FM: indirect method – FM demodulation: frequency discriminator – Non-linear effects in FM systems – Noise in FM receivers – capture effect – pre-emphasis and de-emphasis in FM- Frequency translation – Frequency division multiplexing

UNIT-3	**PULSE MODULATION AND BASEBAND PULSE TRANSMISSION**	**9 HOURS**

Sampling process – PAM – Quantization process –PCM – TDM – Delta modulation, Line coding: unipolar NRZ, Polar NRZ, Unipolar RZ, Manchester – Matched Filter as optimum receiver – Intersymbol Interference – Eye patterns – Nyquist Criterion for distortion less baseband binary transmission – Pulse shaping with raised cosine filter – Duobinary signaling – Adaptive equalization : LMS Algorithm

UNIT-4	**PASSBAND DIGITAL TRANSMISSION AND SPREAD SPECTRUM COMMUNICATION**	**9 HOURS**

Introduction – Coherent Phase shift keying: BPSK, QPSK, OQPSK, π/4 shifted QPSK – QAM-BER analysis of BPSK and QPSK-concepts of MSK-Spread Spectrum: PN sequence and its properties- Direct Sequence Spread Spectrum ,Frequency Hopping Spread Spectrum.

UNIT-5	**INFORMATION THEORY AND CODING**	**9 HOURS**

Entropy and its properties – Source coding theorem: Huffman coding, LZ coding – Discrete Memory less Channel – mutual information and its properties – Channel coding theorem – information capacity theorem; Hamming codes – Convolutional codes – Trellis diagram– Viterbi algorithm – Trellis coded modulation :8 ary PSK.

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications", 2nd Edition, John Wiley & Sons, New Delhi, 2012.
2.	B.P.Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2011

REFERENCE BOOKS	
1.	D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006
2.	A.Papoulis, “Probability, Random variables and Stochastic Processes”, McGraw Hill, 3rd edition, 1991
3.	B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007

Course Code	Course Title	L	T	P	J	C
22ECT402	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the basic building blocks of linear integrated circuits
2. To learn the linear and non-linear applications of operational amplifiers
3. To learn the theory of ADC and DAC
4. To introduce the concepts of waveform generation and introduce some special function ICs
5. To introduce the theory and applications of analog multipliers and PLL

COURSE OUTCOME:

At the end of the course the students will be able to

1. Design linear and nonlinear applications of OP – AMPS
2. Design applications using analog multiplier and PLL
3. Design ADC and DAC using OP – AMPS
4. Analyze special function ICs
5. Gain knowledge of Analog multiplier and PLL

UNIT-1	BASICS OF OPERATIONAL AMPLIFIERS	9 HOURS

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT-2	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9 HOURS

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT-3	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS	9 HOURS
Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters		
UNIT-4	**WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS**	**9 HOURS**
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Switched capacitor filter, Frequency to Voltage and Voltage to Frequency converters.		
UNIT-5	**ANALOG MULTIPLIER AND PLL**	**9 HOURS**
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, closed loop analysis, Voltage controlled oscillator, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization		
TOTAL LECTURE HOURS:		**45 HOURS**
TEXT BOOK(S)		
1.	D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)	
2.	Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)	
REFERENCE BOOKS		
1.	Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015	
2.	Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.	
3.	S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2nd Edition, 4th Reprint, 2016	

Course Code	Course Title	L	T	P	J	C
22ECT403	ELECTROMAGNETIC FIELD THEORY	3	1	0	0	4
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1. To impart knowledge on the basics of static electric field and the associated laws
2. To impart knowledge on the basics of static magnetic field and the associated laws
3. To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
4. To gain the behaviour of the propagation of EM waves
5. To study the significance of Time varying fields.

COURSE OUTCOME:

1. Relate the fundamentals of vector, coordinate system to electromagnetic concepts
2. Analyze the characteristics of Electrostatic field
3. Interpret the concepts of Electric field in material space and solve the boundary conditions
4. Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
5. Determine the significance of time varying fields

UNIT-1	INTRODUCTION	12 HOURS

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem, Verify theorems for different path, surface and volume.

UNIT-2	ELECTROSTATICS	12 HOURS

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT-3	MAGNETOSTATICS	12 HOURS

Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT-4	TIME-VARYING FIELDS AND MAXWELL'S EQUATION	12 HOURS

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations		
UNIT-5	**PLANE ELECTROMAGNETIC WAVES**	**12 HOURS**
Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary		
TOTAL LECTURE HOURS:		**60 HOURS**
TEXT BOOK(S)		
1.	D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002	
2.	M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015	
REFERENCE BOOKS		
1.	Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012.	
2.	W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006	
3.	B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECT404	**CONTROL SYSTEMS**	**3**	**0**	**0**	**0**	**3**
		Syllabus version		v. 1.0		

COURSE OBJECTIVES:

1. To introduce the components and their representation of control systems
2. To learn various methods for analyzing the time response, frequency response and stability of the systems.
3. To learn the various approach for the state variable analysis.

COURSE OUTCOME:

1. Identify the various control system components and their representations.
2. Analyze the various time domain parameters.
3. Analysis the various frequency response plots and its system.
4. Apply the concepts of various system stability criterions.
5. Design various transfer functions of digital control system using state variable models.

UNIT-1	**SYSTEMS COMPONENTS AND THEIR REPRESENTATION**	**9 HOURS**

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory, mathematical modelling of physical systems; Transfer function, block diagrams, signal flow graphs, state-space models.		
UNIT-2	**TIME RESPONSE ANALYSIS**	**9 HOURS**
Time domain analysis: performance specifications, steady state error, transient response of first and second order systems: proportional integral, PI, PD, and PID controllers.		
UNIT-3	**FREQUENCY RESPONSE AND SYSTEM ANALYSIS**	**9 HOURS**
Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system-Bode Plot-Polar Plot, Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation.		
UNIT-4	**CONCEPTS OF STABILITY ANALYSIS**	**9 HOURS**
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.		
UNIT-5	**CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS**	**9 HOURS**
State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.		
TOTAL LECTURE HOURS:		**45 HOURS**
TEXT BOOK(S)		
1.	M.Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.	
2.	J.Nagrath and M.Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition, 2007.	
REFERENCE BOOKS		
1.	K.Ogata, “Modern Control Engineering”, PHI, 5th Edition, 2012.	
2.	S.K.Bhattacharya, “Control System Engineering”, Pearson, 3rd Edition, 2013.	
3.	Benjamin.C.Kuo, “Automatic Control Systems”, Prentice Hall of India, 7th Edition,1995.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECT405	**MICROCONTROLLER BASED SYSTEM DESIGN**	**3**	**0**	**0**	**2**	**4**
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1. Describe the architecture, Instruction sets and peripherals of the 8051 Microcontroller.
2. Write programs for 8051 Microcontroller to interfacing the peripheral devices
3. Describe the architecture, Instruction sets and peripherals of the PIC Microcontroller.
4. Write programs for PIC Microcontroller to interfacing the peripheral devices
5. Distinguish and Summarize the various components in System Design using Microcontrollers.

COURSE OUTCOME:

1. The student would be well versed on the layered communication architectures
2. The student would have gained an understanding of the need for different protocols at the different layers and their interworking.
3. The student will have an exposure to the various digital switching techniques.

UNIT-1	**8051 ARCHITECTURE**	**9 HOURS**
Architecture memory organization addressing modes - instruction set -Timers- Interrupts - I/O ports, Interfacing I/O Devices Assembly language programming - Serial Communication - LCD Display Interfacing Keypad interfacing.		
UNIT-2	**PIC MICROCONTROLLER**	**9 HOURS**
Architecture memory organization-addressing modes instruction set PIC programming in Assembly & C - MP-LAB Interrupts- I/O ports.		
UNIT-3	**PERIPHERAL OF PIC MICROCONTROLLER**	**9 HOURS**
I2C bus Timers -A/D converter D/A Converter -UART- CCP modules Flash and EEPROM memories		
UNIT-4	**INTERFACING WITH PIC**	**9 HOURS**
Interfacing LCD Display Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control Controlling AC appliances Measurement of frequency.		
UNIT-5	**SYSTEM DESIGN-CASE STUDY**	**9 HOURS**
Sensor Interfacing - Standalone Data Acquisition System - case study: Air condition machine - ATM - Ticket vending machine		
	TOTAL LECTURE HOURS:	**45 HOURS**

PROJECT DOMAIN

1. USING 8051 SORT THE ARRAY OF STRINGS
2. TRAFFIC LIGHT CONTROLLER
3. STEPPER MOTOR CONTROLLER

4. A/D AND D/A CONVERTER
5. DIGITAL TACHOMETER

TOTAL PROJECT HOURS: 30 HOURS
TOTAL HOURS :75 HOURS

TEXT BOOK(S)	
1.	Ayala, Kenneth, “The 8051 Microcontroller” Delmar Cengage Learning, 2004.
2.	John Iovine, “PIC Microcontroller Project Book”, McGraw Hill 2004.
REFERENCE BOOKS	
1.	Myke Predko, “Programming and customizing the 8051 Microcontroller”, Tata McGraw Hill 2001.
2.	Michael Slater, “Microcontroller based desing a comprehensive guide to effective Hardware Design”, Prentice Hall, 1989, New Jersey.
3.	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, “PIC Microcontroller and Embedded System using Assembly and C for PIC18”, Pearson Education, 2008.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22NXP401	**(ARMY WING) NCC Credit Course Level - II**	**1**	**0**	**0**	**0**	**1**
		Syllabus version			v. 1.0	

PERSONALITY DEVELOPMENT	**09 HOURS**
PD 3 Group Discussion: Change your mindset, Time Management, Social Skills PD 5 Public Speaking	
LEADERSHIP	**7 HOURS**
L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	
DISASTER MANAGEMENT	**13 HOURS**
DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation DM 2 Initiative Training, Organising Skills, Do's & Don’t's, Natural Disasters, Man Made Disasters DM 3 Fire Service & Fire Fighting	
ENVIRONMENTAL AWARENESS & CONSERVATION	**03 HOURS**
EA 1 Environmental Awareness and Conservation	

GENERAL AWARENESS	**04 HOURS**
GA 1 General Knowledge	
ARMED FORCES	**06 HOURS**
AF 1 Armed Forces, Army, CAPF, Police	
ADVENTURE	**01 HOUR**
AD 1 Introduction to Adventure Activities	
BORDER & COASTAL AREAS	**02 HOURS**
BCA 1 History, Geography & Topography of Border/Coastal areas	
TOTAL PRACTICAL HOURS:	**45 HOURS**

Course Code	Course Title	L	T	P	J	C
22ECP401	LINEAR INTEGRATED CIRCUITS LAB	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To gain hands on experience in designing electronic circuits.
2. To learn simulation software used in circuit design.
3. To learn the fundamental principles of amplifier circuits.
4. To differentiate feedback amplifiers and oscillators.
5. To differentiate the operation of various multivibrators.

COURSE OUTCOME:

1. Analyze various types of feedback amplifiers.
2. Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators.
3. Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators, filters using SPICE Tool.
4. Design amplifiers, oscillators, D-A converters using operational amplifiers.
5. Design filters using op-amp and perform an experiment on frequency response.

LIST OF EXPERIMENTS:	
Design and Analysis of the Following Circuits 1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance 2. RC Phase shift oscillator and Wien Bridge Oscillator 3. Hartley Oscillator and Colpitts Oscillator 4. RC Integrator and Differentiator circuits using Op-Amp 5. Clippers and Clampers 6. Instrumentation amplifier 7. Active low-pass, High pass & Band pass filters 8. R-2R ladder type D-A converter using Op-Amp **Simulation Using SPICE (Using Transistor):** 1. Tuned Collector Oscillator 2. Twin -T Oscillator / Wein Bridge Oscillator 3. Double and Stagger tuned Amplifiers 4. Astable Multivibrator 5. Schmitt Trigger circuit with Predictable hysteresis	
Total Lecture hours:	**45 hours**

Course Code	Course Title	L	T	P	J	C
22ECP402	COMMUNICATION SYSTEMS LAB	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To study the AM & FM Modulation and Demodulation.
2. To learn and realize the effects of sampling and TDM.
3. To understand the PCM & Digital Modulation.
4. To Simulate Digital Modulation Schemes.
5. To Implement Equalization Algorithms and Error Control Coding Schemes.

COURSE OUTCOME:

1. Design AM, FM & Digital Modulators for specific applications.
2. Compute the sampling frequency for digital modulation**.**
3. Simulate & validate the various functional modules of Communication system.
4. Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.

5. Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.
LIST OF EXPERIMENTS:
1. AM- Modulator and Demodulator 2. FM - Modulator and Demodulator 3. Pre-Emphasis and De-Emphasis. 4. Signal sampling and TDM. 5. Pulse Code Modulation and Demodulation. 6. Pulse Amplitude Modulation and Demodulation. 7. Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation. 8. Digital Modulation – ASK, PSK, FSK. 9. Delta Modulation and Demodulation. 10. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes. 11. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes. 12. Simulation of Linear Block and Cyclic Error Control coding Schemes.
Total Laboratory hours: 45 hours

Course Code	Course Title	L	T	P	J	C
22EEP401	**QUANTITATIVE APTITUDE AND LOGICAL REASONING -1**	**0**	**0**	**2**	**0**	**1**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:
1. This module would train the students on the quick ways to solve quantitative aptitude problems and questions applying logical reasoning, within a short time span given during the placement drives.
COURSE OUTCOME:
1. Solve quantitative aptitude problems 2. Apply logical Reasoning 3. Developing quantitative literacy skills
LIST OF EXPERIMENTS:

1. Mock interviews on one-on-one basis 2. Quantitative aptitude 3. Partnership 4. Simple Interest, Compound Interest 5. Profit and Loss 6. Problems on Clock, Calendar and Cubes 7. Permutation and Combination 8. Allegation and mixtures 9. Logical Reasoning 10. Letter and Symbol series 11. Number series 12. Analyzing arguments 13. Making judgments

TOTAL LECTURE HOURS:	**30 Hours**

SEMESTER – V

Course Code	Course Title	L	T	P	J	C
22ECT501	VLSI DESIGN	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1.Understand the fundamentals of IC technology components and their characteristics.

2. Understand combinational logic circuits and design principles.

3. Understand sequential logic circuits and clocking strategies.

4. Understand ASIC Design functioning and design.

5. Understand Memory Architecture and building blocks

COURSE OUTCOME:

CO1: In depth knowledge of MOS technology

CO2: Understand Combinational Logic Circuits and Design Principles

CO3: Understand Sequential Logic Circuits and Clocking Strategies

CO4: Understand Memory architecture and building blocks

CO5: Understand the ASIC Design Process and Testing.

UNIT-1	MOS TRANSISTOR PRINCIPLES	9 HOURS

MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption.

UNIT-2	COMBINATIONAL LOGIC CIRCUITS	9 HOURS

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT-3	SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES	9 HOURS

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Nonbistable Sequential Circuits. Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design .

UNIT-4	INTERCONNECT , MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS	9 HOURS

Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks, Memory Core and Memory Peripherals Circuitry

UNIT-5	ASIC DESIGN AND TESTING	9 HOURS

Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test and verification of complex chips, embedded cores and SOCs, Fault models, Test coding. ASIC Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL, Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

	TOTAL LECTURE HOURS:	45 HOURS

TEXT BOOK(S)

1.	Jan D Rabaey, Anantha Chandrakasan, " Digital Integrated Circuits: A Design Perspective", PHI, 2016.(Units II, III and IV).

2.	Neil H E Weste, Kamran Eshranghian, “ Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009.(Units - I, IV)
3.	Michael J Smith ,” Application Specific Integrated Circuits, Addison Wesley, (Unit - V)
4.	Samir Palnitkar,” Verilog HDL:A guide to Digital Design and Synthesis”, Second Edition, Pearson Education,2003.(Unit - V)
5.	Parag K.Lala,” Digital Circuit Testing and Testability”, Academic Press, 1997, (Unit - V)
REFERENCE BOOKS	
1.	D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
2.	P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
3.	Samiha Mourad and YervantZorian, “Principles of Testing Electronic Systems”, Wiley 2000

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECT502	**DISCRETE TIME SIGNAL PROCESSING**	**2**	**0**	**2**	**2**	**4**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

To learn discrete fourier transform, properties of DFT and its application to linear filtering

● To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands

● To understand the effects of finite precision representation on digital filters

● To understand the fundamental concepts of multi rate signal processing and its applications

● To introduce the concepts of adaptive filters and its application to communication Engineering

COURSE OUTCOME:

CO1: Apply DFT for the analysis of digital signals and systems

CO2: Design IIR and FIR filters

CO3: Characterize the effects of finite precision representation on digital filters

CO4: Design multirate filters

CO5: Apply adaptive filters appropriately in communication systems

UNIT-1	**DISCRETE FOURIER TRANSFORM**	**6 HOURS**

Discrete Fourier transform (DFT) –Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT-2	INFINITE IMPULSE RESPONSE FILTERS	6 HOURS

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT-3	FINITE IMPULSE RESPONSE FILTERS	6 HOURS

Design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations

UNIT-4	FINITE WORD LENGTH EFFECTS	6 HOURS

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error – product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT-5	DSP APPLICATIONS	6 HOURS

Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture Fixed and Floating point architecture principles

	TOTAL LECTURE HOURS:	30 HOURS

PRACTICAL EXERCISE:

Simulation Based Experiment

1. Linear and Circular convolutions.
2. Design of Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
3. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
4. Decimation by polyphase decomposition.

Processor Based Experiment

5. Perform MAC operation using various addressing modes.
6. Implementation of linear and circular convolution.

TOTAL PRACTICAL HOURS:30 HOURS

PROJECT:

1. Design and Simulation of a project involving MATLAB Software related to Signal Processing
2. Documentation of the above project

TOTAL PROJECT HOURS:30 HOURS

TOTAL HOURS :90 HOURS

TEXT BOOK(S)	
1.	John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2.	A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004
REFERENCE BOOKS	
1.	Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2.	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3.	Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

Course Code	Course Title	L	T	P	J	C
22ECT503	WIRELESS COMMUNICATION	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To study and understand the concepts and design of a Cellular System.
- To Study And Understand Mobile Radio Propagation And Various Digital ModulationTechniques.
- To Understand The Concepts Of Multiple Access Techniques And Wireless Networks

COURSE OUTCOME:

CO1:Understand The Concept And Design Of A Cellular System.
CO2:Understand Mobile Radio Propagation And Various Digital dulation Techniques.
CO3:Understand The Concepts Of Multiple Access Techniques and Wireless Networks
CO4:Characterize a wireless channel and evolve the system design specifications
CO5:Design a cellular system based on resource availability and traffic demands.

UNIT-1	THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS	9 HOURS

Introduction-Frequency Reuse - Channel Assignment Strategies - Handoff Strategies: PrioritizingHandoffs, Practical Handoff Considerations. Interference And System Capacity: Co-Channel Interference And System Capacity - Channel Planning For Wireless Systems, Adjacent Channel Interference, Power Control For Reducing Interference, Trunking And Grade Of Service. Improving Coverage And Capacity In Cellular Systems: Cell Splitting, Sectoring.

UNIT-2	MOBILE RADIO PROPAGATION	9 HOURS

Large Scale Path Loss: Introduction To Radio Wave Propagation - Free Space Propagation Model– **Three Basic Propagation Mechanism:** Reflection – Brewster Angle- Diffraction-Scattering.**Small Scale Fading And Multipath:** Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread And Coherence Time. **Types Of Small- Scale Fading:** Fading Effects Due To Multipath Time Delay Spread, Fading Effects Due To Doppler Spread

UNIT-3	MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY	9 HOURS
Digital Modulation – An Overview: Factors That Influence The Choice Of Digital Modulation, **Linear Modulation Techniques:** Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK), **Spread Spectrum Modulation Techniques:** Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation Performance In Fading And Multipath Channels- **Equalization** Fundamentals Of Equalization **: Diversity Techniques:** Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity		
UNIT-4	**MULTIPLE ACCESS TECHNIQUES**	**9 HOURS**
Introduction: Introduction To Multiple Access- Frequency Division Multiple Access(FDMA)- Time Division Multiple Access(TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access(CDMA)- Space Division Multiple Access(SDMA)- **Capacity Of Cellular Systems:** Capacity Of Cellular CDMA, Capacity Of CDMA With Multiple Cells		
UNIT-5	**WIRELESS NETWORKING**	**9 HOURS**
Introduction: Difference Between Wireless And Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), **Development Of Wireless Networks:** First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, **Traffic Routing In Wireless Networks**: Circuit Switching, Packet Switching- **Personal Communication Services/ Networks(PCS/PCNs):**Packet Vs Circuit Switching For PCN, Cellular Packet- Switched Architecture- Packet Reservation Multiple Access(PRMA)- **Network Database**s**:** Distributed Database For Mobility Management- Universal Mobile Telecommunication Systems(UMTS)		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Rappaport,T.S.,-Wireless communications", Pearson Education, Second Edition, 2010
2.	Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011

REFERENCE BOOKS

1.	Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, ArtechHouse, 2000
2.	David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, CambridgeUniversity Press, 2005
3.	Upena Dalal, —Wireless Communication", Oxford University Press, 2009.

Course Code	Course Title	L	T	P	J	C
22EET501	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1.Acquire knowledge of economics to facilitate the process of economic decision making
2.Acquire knowledge on basic financial management aspects
3.Develop the skills to analyze financial statements

COURSE OUTCOMES:

1.Evaluate the economic theories, cost concepts and pricing policies
2.Understand the market structures and integration concepts
3.Understand the measures of national income, the functions of banks and concepts of globalization
4.Apply the concepts of financial management for project appraisal
5.Understand accounting systems and analyze financial statements using ratio analysis

UNIT-1	**ECONOMICS, COST AND PRICING CONCEPTS**	**9 HOURS**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual cost and opportunity cost – Incremental cost and sunk cost – Fixed and variable cost – Marginal costing – Total cost – Elements of cost – Cost curves – Breakeven point and breakeven chart – Limitations of breakeven chart – Interpretation of breakeven chart –Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies –Pricing methods.

UNIT-2	**CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES**	**9 HOURS**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger –Horizontal integration

UNIT-3	**NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT**	**9 HOURS**

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

UNIT-4	**CONCEPTS OF FINANCIAL MANAGEMENT**	**9 HOURS**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

UNIT-5	**VACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS**	**9 HOURS**

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Total Lecture hours:	**45 hours**

Text Book(s)

1.	Prasanna Chandra, — Financial Management (Theory & Practice) TMH
2.	Weston & Brigham, — Essentials of Managerial Finance
Reference Books	
1.	Pandey, I. M., —Financial Management
2.	Fundamentals of Financial Management - James C. Van Horne.
3.	://stanford.edu/dept/MSandE

Course Code	Course Title	L	T	P	J	C
22ECP501	VLSI LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To learn Hardware Descriptive Language (Verilog/VHDL).
2. To learn the fundamental principles of Digital System Desing using HDL and FPGA.
3. To learn the fundamental principles of VLSI circuit design in digital domain
4. To learn the fundamental principles of VLSI circuit design in analog domain
5. To provide hands on design experience with EDA platforms.

COURSE OUTCOME:

CO1: Write HDL code for basic as well as advanced digital integrated circuit

CO2: Import the logic modules into FPGA Boards

CO3: Synthesize Place and Route the digital Ips

CO4: Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools

CO5: Test and Verification of IC design

LIST OF EXPERIMENTS:

1. Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design an Adder ; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software
4. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera

Software and implement by Xilinx/Altera FPGA

6. Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
8. Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout .
9. Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout
10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier.

TOTAL: 60 PERIODS

Course Code	Course Title	L	T	P	J	C
22ECP502	SIMULATION LABORATORY	0	0	3	0	1.5
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To use SPICE software for circuit design
2. Gain hands on experience in designing electronic circuits
3. Acquire the fundamental principles of amplifier circuits using MATLAB tools.

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Become familiar with the basic circuit components and know how to connect them to make a real electrical circuit.

CO2: Be able to verify the laws and principles of electrical circuits, understand the relationships and differences between theory and practice.

CO3: Be able to gain practical experience related to electrical circuits, stimulate more interest and motivation for further studies of electrical circuits.

CO4: Design, Simulate and using MATLAB simulator tools.

CO5: Simulate the DC Network to determine the Thevenin's and Norton Equivalent.

LIST OF EXPERIMENTS

1. Transient characteristic of a given RLC circuit.
2. Analysis of Frequency Response of BJT using Spice
3. VI characteristics of a PN junction diode and DC transfer characteristics of a circuit having Zener diode.
4. Calculate the output response of the op-amp circuit.

5. Develop a Simulink model for single phase rectifier circuit. 6. Develop a Simulink model for ideal switching device solution method to simulate a full wave rectifier using ideal diodes. 7. PSPICE simulation of Nodal analysis for DC circuits 8. PSPICE simulation of D.C. circuit for determining Thevenin's and Norton's equivalent. 9. PSPICE SIMULATION OF D.C. network with sub circuit.

TOTAL LECTURE HOURS:	**45 HOURS**

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22EEP501	**INTERNSHIP**	**0**	**0**	**0**	**0**	**1**
Pre-requisite	Completion of minimum of Two semesters	**Syllabus version**			**v. 1.0**	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To enhance the knowledge of the students in professional engineering practice sought through industrial training on different current technologies.
2.To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.
3.To employ the students in industrial projects and strengthen the practical skills of the students.
4.To develop significant commitment in the students' profession and specialization.

COURSE OUTCOMES: After completion of this course, the students should be able to

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Extend the knowledge through research and development in the chosen fields of specialization.

1.Four weeks of work at industry site and Supervised by an expert at the industry.
2.Mode of Evaluation: Internship Report, Presentation and Project Review
3.The students individually undertake training in reputed Mechanical, Mechatronics and Automation engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

TOTAL: 04 WEEKS

SEMESTER VI

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECT601	**TRANSMISSION LINES AND RF SYSTEMS**	**3**	**1**	**0**	**0**	**4**
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1. To introduce the various types of transmission lines and its characteristics.
2. To understand high frequency line, power and impedance measurements.
3. To impart technical knowledge in impedance matching using Smith Chart.
4. To introduce passive filters and basic knowledge of active RF components
5. To learn the concepts of a RF system transceiver design.

COURSE OUTCOME:

1. Explain the characteristics of transmission lines and its losses.
2. Calculate the standing wave ratio and input impedance in high frequency transmission lines.
3. Analyze impedance matching by stubs using Smith Charts.
4. Comprehend the characteristics of TE and TM waves.
5. Design a RF transceiver system for wireless communication.

UNIT-1	**TRANSMISSION LINE THEORY**	**9 HOURS**

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion less line - Loading and different methods of loading - Line not terminated in Z 0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT-2	**HIGH FREQUENCY TRANSMISSION LINES**	**9 HOURS**

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT-3	**IMPEDANCE MATCHING IN HIGH FREQUENCY LINE**	**9 HOURS**

Impedance matching: Quarter wave transformer ,One Eighth wave line, Half wave line- Impedance matching by stubs- Single stub and double stub matching - Smith chart – Application of Smith chart, Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT-4	**WAVEGUIDES**	**9 HOURS**

Waves between parallel planes of perfect conductors- Transverse Electric waves and Transverse Magnetic waves, Characteristics of TE and TM waves, Transverse Electromagnetic waves, TM and TE waves in Rectangular waveguides, TM and TE waves in Circular waveguides.

UNIT-5	**RF SYSTEM DESIGN CONCEPTS**	**9 HOURS**

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Fundamentals of MMIC, Basic concepts of RF design: Filters, couplers, power dividers, Amplifier power relations, Low noise amplifiers, Power amplifiers.	
TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)	
1.	John D Ryder, "Networks lines and fields",Prentice Hall of India,New Delhi,2005.(Unit I–IV).
2.	Mathew M. Radmanesh, "Radio Frequency &Microwave Electronics", Pearson Education Asia, Second Edition, 2002 (Unit – V).
3.	Annapurna Das, Sisir K. Das, "Microwave Engineering", McGraw Hill Education (India) private limited, Third edition,2000.(Unit – V)
REFERENCE BOOKS	
1.	Reinhold Ludwig and Powel Bretchko, "RF Circuit Design" – Theory and Applications", Pearson Education Asia, First Edition, 2001.
2.	D. K. Misra, "Radio Frequency and Microwave Communication Circuits"- Analysis and Design, John Wiley & Sons, 2004.
3.	W.Alan Davis, Krishna Agarwal, "Radio Frequency Circuit Design", John willy & Sons,2001.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECT602	**EMBEDDED SYSTEMS AND IOT DESIGN**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Learn the architecture and features of 8051.
2. Study the design process of an embedded system.
3. Understand the real – time processing in an embedded system.
4. Learn the architecture and design flow of IoT.
5. Build an IoT based system

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Explain the architecture and features of 8051.
CO2: Develop a model of an embedded system.
CO3: List the concepts of real time operating systems.
CO4: Learn the architecture and protocols of IoT.
CO5: Design an IoT based system for any application.

UNIT-1	**8051 MICROCONTROLLER**	**9 HOURS**

Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

UNIT-2	**EMBEDDED SYSTEMS**	**9 HOURS**
Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.		
UNIT-3	**PROCESSES AND OPERATING SYSTEMS**	**9 HOURS**
Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.		
UNIT-4	**IOT ARCHITECTURE AND PROTOCOLS**	**9 HOURS**
Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.		
UNIT-5	**IOT SYSTEM DESIGN**	**9 HOURS**
Basic building blocks of an IoT device – Raspberry Pi – Interfaces – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)
2.	Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.(Unit – II,III)
3.	Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.(Unit – IV,V)

REFERENCE BOOKS

1.	Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
2.	Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.
3.	Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.

Course Code	Course Title	L	T	P	J	C
22EEP601	QUANTITATIVE APTITUDE AND LOGICAL REASONING II	0	0	2	0	1
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

The objective of this course is to provide the students with a solid foundation of quantitative aptitude and logical reasoning concepts. This course aims to help students develop their analytical and problem-solving skills, which are essential for success in various competitive exams and real-life situations.		
COURSE OUTCOMES: After completion of this course, the students should be able to		
1.Understand the basic concepts of quantitative aptitude and logical reasoning. 2.Apply quantitative techniques in solving real-world problems related to profit & loss, SI & CI etc. 3.Apply logical reasoning skills to analyze and solve complex problems work and time, time and distance etc. 4.Interpret and analyze data using various mathematical and statistical techniques		
UNIT-I	**PROFIT AND LOSS**	**05 HOURS**
Concept Explanation, Profit, Loss, Cost Price, Selling Price, Marked Price, Formula, Examples, Tricks.		
UNIT-II	**COMMERCIAL MATHEMATICS**	**07 HOURS**
Simple Interest, Compound Interest, basic formulas, equal annual installment, Difference between simple interest & compound interest, Application of digital sum in SI & CI, Successive percentages in SI & CI, Population formula, growth rate, Offering Loan on a Discount, Shortcut methods.		
UNIT-III	**AVERAGE, MIXTURE & ALLIGATION**	**08 HOURS**
Concept Explanation, Average Formula to calculate the Mean, Median, Mode, Average formula for An AP Series, Mixtures & Alligation, Rule of weighted averages, Rule of alligation, Alligation cross, Alligation line, Successive replacement.		
UNIT-IV	**WORK AND TIME**	**05 HOURS**
Unit Work, Combined Work, basic formulas, Efficiency Vs Time taken, Chain Rule Concept, 8 rules of Time and Work, Pipes and Cisterns, 4 Rules of Pipes and Cistern.		
UNIT-V	**TIME SPEED DISTANCE**	**05 HOURS**
Basic formulas, Basic speed when Time is constant, Average speed when Speed is constant relationships, Concept of average speed, Average speed when Distance is constant, Average, Acceleration & deceleration, Concept of relative speed, Concept of resultant speed. **Applications-**Application of relative speed in train problems, boats & streams problems, basic formulas, shortcut methods, 4 rules of boats & streams, The escalator problems, circular motion tips, concept of races		
	TOTAL PRACTICAL HOURS:	**30 HOURS**

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22EEP602	**COMPREHENSIVE ASSESSMENT**	**0**	**0**	**2**	**0**	**1**
		Syllabus version			**v. 1.0**	

COURSE OBJECTIVES:

To provide a thorough understanding of node and mesh analysis techniques and their applications in electrical circuits.

To Understanding Signal Processing Concepts.

To Understanding Semiconductor Physics and Devices.

To Understanding Digital Logic and Circuit Design.

To Understanding Control Systems and Stability Analysis

COURSE OUTCOME:

Upon completion of this course, students will be able to:

CO1:Able to solve complex electrical circuits using diffirenrt analysis.
CO2: Able to apply these concepts to analyze and process signals in both continuous and discrete domains.
CO3: Able to explain the diodes, fundamental concepts of semiconductor physics, including energy bands, direct and indirect band-gap semiconductors
CO 4: understand and apply the principles of digital logic and circuit design
CO5: Able to analyze and design control systems using principles of feedback, transfer functions, to evaluate the stability and performance of control systems

UNIT-1	**NETWORKS ANALYSIS**	**9 HOURS**

Node and mesh analysis - Superposition, Thevenin's theorem, Norton's theorem & reciprocity - Sinusoidal steady state analysis: phasors, complex power - Maximum power transfer -Time and frequency domain analysis of linear circuits such as RL, RC and RLC circuits - Solution of network equations using Laplace transform - Linear 2-port network parameters, wye-delta transformation.

UNIT-2	**SIGNAL & SYSTEMS**	**9HOURS**

Fourier series - Fourier transform -Sampling theorem and applications -DTFT, DFT, z-transform - Discrete-time processing of continuous-time signals - LTI systems: definition and properties, causality & stability, their impulse response & convolution, poles & zeroes - Frequency response, group delay, phase delay.

UNIT-3	**ELECTRONIC DEVICES**	**9 HOURS**

Energy bands in semiconductors - Direct and indirect band-gap semiconductors - P-N junction &Zener diode - BJT, MOS capacitor & MOSFET-Diffusion current & drift current - Amplifiers – Biasing Ac coupling - small signal analysis - frequency response - Current mirrors & differential amplifier.

UNIT-4	**DIGITAL CIRCUITS**	**9HOURS**

Binary Number system - Integer & floating-point- numbers - Boolean algebra - Minimization of Boolean functions using Boolean identities &Karnaugh map - Logic gates & their static CMOS implementations - Arithmetic circuits - Code converters - Multiplexers & decoders - Latches & flip-flops - Propagation delay & critical path delay - Setup and hold time.		
UNIT-5	**CONTROL SYSTEMS**	**9 HOURS**
Feedback principle - Transfer function -Block diagram representation - Signal flow graph Frequency response -Routh-Hurwitz &Nyquist stability criteria - Bode and root-locus plots - Lag, lead & lag lead compensation - State variable model - Solution of state equation of LTI systems.		
TOTAL LECTURE HOURS:		**45 HOURS**
TEXT BOOK(S)		
1.	Circuit Theory and Design" by Robert L. Boylestad	
2.	Digital Signal Processing: Principles, Algorithms, and Applications" by John G. Proakis and Dimitris G. Manolakis	
3.	Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011	
REFERENCE BOOKS		
1.	Engineering Circuit Analysis" by William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin	
2.	Semiconductor Physics and Devices" by Donald A. Neamen	
3.	Digital Design" by M. Morris Mano and Michael D. Ciletti	
4.	Modern Control Engineering" by Katsuhiko Ogata	
5.	Control Systems Engineering" by I.J. Nagrath and M. Gopal	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECP601	**EMBEDDED SYSTEMS LABORATORY**	**0**	**0**	**4**	**0**	**2**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Gain hands on experience in 8051.
2. Generate waveforms in 8051.
3. Learn the working of ARM processor
4. Write programs to interface various peripherals and I/Os with ARM processor.
5. Build an IoT based system

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Write programs for in 8051.

CO2: Write programs in 8051 ports.

CO3: Interface memory, A/D and D/A convertors with ARM processor

CO4: Write program for interfacing keyboard, display, motor and sensor.
CO5: Formulate a mini project using embedded system.

LIST OF EXPERIMENTS

Experiments using 8051

1. Programming Arithmetic and Logical Operations in 8051.
2. Generation of Square waveform using 8051.
3. Programming using On – Chip ports in 8051.
4. Programming using Serial Ports in 8051.
5. Design of a Digital Clock using Timers/Counters in 8051.

Experiments using ARM

1. Interfacing ADC and DAC
2. Blinking of LEDs and LCD
3. Interfacing Keyboard
4. Interfacing Stepper Motor

Miniprojects for IoT

1. Garbage Segregator and Bin Level Indicator
2. Colour based Product Sorting
3. Image Processing based Fire Detection
4. Vehicle Number Plate Detection
5. Smart Lock System

TOTAL LECTURE HOURS:	**60 Hours**

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**J**	**C**
22NXP601	**NCC Credit Course Level III*(NAVAL WING)**	**1**	**0**	**0**	**0**	**1**
		Syllabus version			**v. 1.0**	

UNIT-I	**NCC GENERAL**	**3 HOURS**

NCC 1 Aims, Objectives & Organization of NCC/NCC 2 Incentives
NCC 3 Duties of NCC Cadet
NCC 4 NCC Camps: Types & Conduct

UNIT-II	**NATIONAL INTEGRATION AND AWARENESS**	**3 HOURS**

NI 1 National Integration: Importance & NecessityNI 2
Factors Affecting National Integration
NI 3 Unity in Diversity & Role of NCC in Nation Building
NI 4 Threats to National Security

UNIT-III	**PERSONALITY DEVELOPMENT**	**3 HOURS**

PD 1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem SolvingPD 2 Communication Skills
PD 3 Group Discussion: Stress & Emotions

UNIT-IV	**LEADERSHIP**	**2 HOURS**

L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour CodeL 2
Case Studies: Shivaji, Jhasi Ki Rani

UNIT-V	SOCIAL SERVICE AND COMMUNITY DEVELOPMENT	4 HOURS
SS 1 Basics, Rural Development Programmes, NGOs, Contribution o YouthSS 2 Protection of Children and Women Safety SS 3 Road / Rail Travel SafetySS 4 New Initiatives SS 5 Cyber and Mobile Security Awareness		
	TOTAL PRACTICAL HOURS	**15 HOURS**

SEMESTER VII

Course Code	Course Title	L	T	P	J	C
22ECT701	ANTENNAS AND MICROWAVE ENGINEERING	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To enable the student to understand the basic principles in antenna and microwave system design
2. To enhance the student knowledge in the area of various antenna designs.
3. To enhance the student knowledge in the area of microwave components and antenna for practical applications.

COURSE OUTCOME:

1. Apply the basic principles and evaluate antenna parameters and link power budgets
2. Design and assess the performance of various antennas
3. Design a microwave system given the application specifications

UNIT-1	**INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS**	**9 HOURS**

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Impedance matching, Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver.

UNIT-2	**RADIATION MECHANISMS AND DESIGN ASPECTS**	**9 HOURS**

Radiation Mechanisms of Linear Wire and Loop antennas, Aperture antennas, Reflector antennas, Microstrip antennas and Frequency independent antennas, Design considerations and applications.

UNIT-3	**ANTENNA ARRAYS AND APPLICATIONS**	**9 HOURS**

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas

UNIT-4	**PASSIVE AND ACTIVE MICROWAVE DEVICES**	**9 HOURS**

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Single cavity Klystron -Reflex klyston oscillator, TWT, Magnetron.

UNIT-5	**MICROWAVE DESIGN PRINCIPLES**	**9 HOURS**

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fourth Edition, Tata McGraw-Hill, 2006. (UNIT I, II, III)
2.	David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.(UNIT I,IV,V)
REFERENCE BOOKS	
1.	Constantine A.Balanis, “Antenna Theory Analysis and Design”, Third edition, John Wiley India Pvt Ltd., 2005.
2.	R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press, 2001

Course Code	Course Title	L	T	P	J	C
22ECP701	ADVANCED COMMUNICATION LABORATORY	0	0	4	0	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- Understand the working principle of optical sources, detector, fibers
- Develop understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand and capture an experimental approach to digital wireless communication
- Understand actual communication waveforms that will be sent and received across wireless channel

COURSE OUTCOME:

1. Analyze the performance of simple optical link by measurement of losses and Analyzing the mode characteristics of fiber
2. Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER
3. Estimate the Wireless Channel Characteristics and Analyze the performance of Wireless Communication System
4. Understand the intricacies in Microwave System design

LIST OF EXPERIMENTS

1. Measurement of connector, bending and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. DC Characteristics of LED and PIN Photo diode.
4. Fiber optic Analog and Digital Link Characterization - frequency response(analog), eye diagram and BER (digital)
5. Wireless Channel Simulation including fading and Doppler effects
6. Simulation of Channel Estimation, Synchronization & Equalization techniques
7. Analyzing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios

8. OFDM Signal Transmission and Reception using Software Defined Radios.
9. VSWR and Impedance Measurement and Impedance Matching
10. Characterization of Directional Couplers, Isolators, Circulators
11. Gunn Diode Characteristics
12. Microwave IC – Filter Characteristics

TOTAL LECTURE HOURS:	**30 Hours**

Course Code	Course Title	L	T	P	J	C
22EEP701	PRODUCT DESIGN AND DEVELOPMENT	0	0	0	4	2
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

To train the students in

1. Identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
2. Conducting experiments, analyze and discuss the test results, and make conclusions.
3. Preparing project reports and presentation

COURSE OUTCOME:

At the end of the project, the student will be able to

CO1: Formulate and analyze problem / create a new product/ process.

CO2: Design and conduct experiments to find solution

CO3: Analyze the results and provide solution for the identified problem, prepare project report and make presentation.

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

Course Code	Course Title	L	T	P	J	C
22EEP702	INTERNSHIP	0	0	0	0	1
Pre-requisite		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:
1.To enhance the knowledge of the students in professional engineering practice sought through industrial training on different current technologies. 2.To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen. 3.To employ the students in industrial projects and strengthen the practical skills of the students. 4.To develop significant commitment in the students' profession and specialization.
COURSE OUTCOMES: After completion of this course, the students should be able to
1. Have an exposure to industrial practices and to work in teams 2. Communicate effectively 3. Understand the impact of engineering solutions in a global, economic, environmental and societal context 4. Develop the ability to engage in research and to involve in life-long learning 5. Extend the knowledge through research and development in the chosen fields of specialization.
1.Four weeks of work at industry site and Supervised by an expert at the industry. 2.Mode of Evaluation: Internship Report, Presentation and Project Review 3.The students individually undertake training in reputed Mechanical, Mechatronics and Automation engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.
TOTAL: 04 WEEKS

SEMSTER VIII

Course Code	Course Title	L	T	P	J	C
22ECJ801	**PROJECT WORK**	**0**	**0**	**0**	**16**	**8**

		Syllabus version	**v. 1.0**

COURSE OBJECTIVES: After studying this course, you should be able to:
To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.
COURSE OUTCOMES: After completion of this course, the students should be able to
Upon successful completion of the course, the student will be able to On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.
The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL HOURS	**300 HOURS**

VERTICALS
SEMICONDUCTOR CHIP DESIGN AND TESTING

Course Code	Course Title	L	T	P	J	C

22ECE001	WIDE BANDGAP DEVICES	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- Introduce the concept of wide band gap (WBG) devices and its application in real world
- Advantages and disadvantages of WBG devices
- Provide an introduction to basic operation of WBG power devices
- Learn Design principles of modern power devices
- Ability to deal high frequency design complexity

COURSE OUTCOME:

CO1: Students master design principles of power devices

CO2: Students become familiar with reliability issues and testing methods

CO3: An ability to design and conduct experiments, as well as to analyze and interpret data

CO4: Student to get real life experience and to know practical applications of WBG

CO5: Indepth knowledge on practical usage of this technology

UNIT-1	WBG DEVICES AND THEIR APPLICATION IN REAL WORLD	6 HOURS

Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology - Advantages and disadvantages

UNIT-2	SWITCHING CHARACTERIZATION OF WBG	6 HOURS

Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up

UNIT-3	DRIVERS FOR WIDE BAND GAP DEVICES	6 HOURS

Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices, Transient immunity integrated gate drivers

UNIT-4	HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING	6 HOURS

Effects of parasitic inductance, Effects of parasitic capacitance, EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB

UNIT-5	APPLICATIONS OF WIDE BANDGAP DEVICES	6 HOURS

Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications, Renewable energy sources applications	
TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERSICE:

1. Conduct switching loss and Magnetic loss on Low side
2. Conduct Double pulse test (DPT) and learn IEC 60747 -8/9 standards
3. Conduct experiments for Diode reverse recovery on High side
4. Conduct Power analysis and harmonic measurement
5. Measure Turn on /off delay, Calculate recovery softness factor, measure reverse recovery energy.

TOTAL PROJECT HOURS:30 HOURS
TOTAL HOURS :60 HOURS

TEXT BOOK(S)

1.	A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Convertion, Wiley, 2014, ISBN-13: 978-1118844762
2.	G. Meneghesso, M. Meneghini, E. Zanoni, “Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion,” Springer International Publishing, 2018, ISBN: 978-3- 319-77993-5

REFERENCE BOOKS

1.	F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018)
2.	B.J.Baliga, “Gallium Nitride and Silicon Carbide Power Devices,” World Scientific Publishing Company (3 Feb. 2017).
3.	L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, “Digital Control of HighFrequency Switched-Mode Power Converters”, Wiley, ISBN-13: 978-1118935101 (9th June, 2015)

Course Code	Course Title	L	T	P	J	C
22ECE002	VALIDATION AND TESTING TECHNOLOGY	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- Getting familiar with various IC technology.
- Learn MOS theory and testing
- Learn CMOS circuit theory and testing
- Getting expertise on CMOS characterization.
- Explore circuit and device level testing methods

COURSE OUTCOME:

CO1: Complete overview to CMOS fabrication process.
CO2: Understand the fundamental concept of MOS FET and testing.
CO3: Explain the concept of MOS theory and analysis.
CO4: To give the student an understanding of CMOS performance testing and estimation.
CO5: Explain the basics of Testing and Fault Modeling

UNIT-1	**TECHNOLOGY INTRODUCTION**	**6 HOURS**

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

UNIT-2	**MOS THEORY ANALYSIS-I**	**6 HOURS**

Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.

UNIT-3	**MOS THEORY ANALYSIS- II**	**6 HOURS**

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT-4	**CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION**	**6 HOURS**

Sheet Resistance RS, conductivity and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.

UNIT-5	**BASIC OF SILICON VALIDATION**	**6 HOURS**

Need for Testing, testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.

TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. MOS TESTING for Ids-Vds Relationships
2. MOSFET testing for threshold voltage like Vth, gate breakdown voltage.
3. Sheet resistivity measurement.

4. Conductivity measurement.
5. Inverter testing
6. Designing of CMOS inverter/ logic gate and testing of delay estimation. List of Equipment needed for a batch of 30 students (3 in a bench):

- Dual channel SMU for MOSFET testing with Test script processor and IV software: 2 nos (one setup for three students)
- Resistivity and Conductivity Setup – #2 setups
- I-V SMU analyser
- Four Point Collinear Resistivity Measurement Setup
- Resistivity samples #2
- Conductivity Samples #2
- Inverter testing setup: power suppy #1, Scope with AFG and power application: #1no
- Xilinx /CAD: 5 no.

TEXT BOOK(S)

1.	Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.
2.	Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education, 1999.

REFERENCE BOOKS

1.	M.L. Bushnell and V.D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2004
2.	N.K. Jha and S.G. Gupta, “Testing of Digital Systems”, Cambridge University Press, 2003
3.	Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005

Course Code	Course Title	L	T	P	J	C
22ECE003	LOW POWER IC DESIGN	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To learn the fundamentals of low power low voltage VLSI design.
2. To understand the impact of power on system performances.
3. To understand the different design approaches.
4. To develop the low power low voltage memories

COURSE OUTCOME:

CO1: Understand the fundamentals of Low power circuit design.

CO2: Attain the knowledge of architectural approaches.

CO3: Analyze and design Low-Voltage Low-Power combinational circuits.

CO4: Learn the design of Low-Voltage Low-Power Memories

CO5: Design and develop Low Power, Low Voltage Circuits		
UNIT-1	**FUNDAMENTALS OF LOW POWER CIRCUITS**	**6 HOURS**
Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect		
UNIT-2	**LOW-POWER DESIGN APPROACHES**	**6 HOURS**
Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures		
UNIT-3	**LOW-VOLTAGE LOW-POWER ADDERS**	**6 HOURS**
Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, LowVoltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, LowVoltage Low-Power Logic Styles		
UNIT-4	**LOW-VOLTAGE LOW-POWER MULTIPLIERS**	**6 HOURS**
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier		
UNIT-5	**LOW-VOLTAGE LOW-POWER MEMORIES**	**6 HOURS**
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, LowPower SRAM Technologies, Basics of DRAM, Self-Refres Circuit, Future Trend and Development of DRAM		
	TOTAL LECTURE HOURS:	**30 HOURS**
PRACTICAL EXERCISES:		**30 PERIODS**
1. Modeling and sources of power consumption 2. Power estimation at different design levels (mainly circuit, transistor, and gate) 3. Power optimization for combinational circuits 4. Power optimization for sequential circuits 5. Power optimization for RT and algorithmic levels		
		TOTAL HOURS: 60 PERIODS
TEXT BOOK(S)		
1.	Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011	
2.	Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004	
REFERENCE BOOKS		
1.	Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012	

2.	Anantha Chandrakasan, “Low Power CMOS Design”, IEEE Press, /Wiley International, 1998
3.	Kaushik Roy, Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley, & Sons, 2000
4.	Gary K. Yeap, “Practical Low Power Digital VLSI Design”, Kluwer Academic Press, 2002

Course Code	Course Title	L	T	P	J	C
22ECE004	VLSI TESTING AND DESIGN FOR TESTABILITY	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To introduce logic and fault simulation and testability measures.
- To study the design for testability.
- To know about interfacing and testing of memory
- To introduce power management techniques in testing
- To study testability in analog circuits

COURSE OUTCOME:

CO1: Understand logic and fault simulation requirements and testability measures.
CO2: Understand the Design for Testability.
CO3: Develop interfacing and memory testing.
CO4: Perform testing with power management techniques.
CO5: Carry-out fault Detection in analog circuits.

UNIT-1	TEST REQUIREMENTS AND METRICS	9 HOURS

Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St- BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimisations.

UNIT-2	SCAN DESIGN AND BIST	9 HOURS

Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.

UNIT-3	MEMORY TEST AND TEST INTERFACES	9 HOURS

Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-

Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan		
UNIT-4	**DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST**	**9 HOURS**
Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations		
UNIT-5	**ANALOG TEST**	**9 HOURS**
Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,Vishwani Agrawal and Michael Bushnell, Springer, 2002	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE005	**MIXED SIGNAL IC DESIGN TESTING**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To know about mixed-signal devices and the need for testing these devices.
- To study the various techniques for testing.
- To learn about ADC and DAC based testing.
- To understand the Clock and Serial Data Communications Channels
- To study the general purpose measuring devices.

COURSE OUTCOME:

CO1: Learn the fundamentals of mixed signal circuits.

CO2: Define the various measurement terminologies.

CO3: Acquire knowledge of Analog to Digital Converters.

CO4: Learn testing of Analog to Digital Converters.

CO5: Comprehend the attributes of a clock signal.

UNIT-1	**MIXED – SIGNAL TESTING**	**6 HOURS**

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits - Post- Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature		
UNIT-2	**YIELD, MEASUREMENT ACCURACY, AND TEST TIME**	**6 HOURS**
Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guardbands - Effects of Measurement Variability on Test Yield - Effects of Reproducibilty and Process Variation on Yield - Statistical Process Control		
UNIT-3	**DAC TESTING**	**6 HOURS**
Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications		
UNIT-4	**ADC TESTING**	**6 HOURS**
ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications		
UNIT-5	**CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREMENT**	**6 HOURS**
Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

DESIGN AND TESTING OF THE FOLLOWING CIRCUITS

1. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
2. R-2R Ladder Type and Flash Type ADC.
3. DC power supply using LM317 and LM723.
4. Design of asynchronous counter
5. Design of synchronous counter
6. Implementation and Testing of RS Latch and Flip-flops

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Gordon W.Roberts, Friedrich Taenzler, Mark Burns, “An Introduction to Mixed-signal IC Test and Measurement” Oxford University Press, Inc.2012 (Unit I - V)
2.	M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002. (Unit - III)
3.	BapirajuVinnakota, “Analog and mixed-signal test”, Prentice Hall, 1998.(Unit - II)

4.	Digital and Analogue Instrumentation: Testing and Measurement by Nihal Kularatna

Course Code	Course Title	L	T	P	J	C
22ECE006	ANALOG IC DESIGN	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To study the basics of MOS Circuits.
- To analyse the noise characteristics of amplifiers.
- To study the performance parameters of amplifiers.
- To comprehend the compensation techniques
- To understand the detection and testing of faults.

COURSE OUTCOME:

CO1: Design amplifiers to meet user specifications.

CO2: Analyse the frequency and noise performance of amplifiers.

CO3: Design and analyse feedback amplifiers and one stage op amps.

CO4: Analyse stability of op amp

CO5: Testing experience of logic circuits

UNIT-1	SINGLE STAGE AMPLIFIERS	6 HOURS

Basic MOS physics and equivalent circuits and models, CS, CG and Source Follower, differential amplifier with active load, Cascode and Folded Cascode configurations with active load, design of Differential and Cascode Amplifiers – to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT-2	HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS	6 HOURS

Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT-3	FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS	6 HOURS

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT-4	STABILITY , FREQUENCY COMPENSATION	6 HOURS
Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.		
UNIT-5	**LOGIC CIRCUIT TESTING**	**6 HOURS**
Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Design a CMOS inverter and analyze its characteristics.
2. Design a Common source amplifier and analyze its performance.
3. Design a Common drain amplifier and analyze its performance.
4. Design a Common gate amplifier and analyze its performance.
5. Design a differential amplifier with resistive load using transistors.
6. Design three stage and five stage ring oscillator circuit and compare its frequencies. List of equipment needed for a batch of 30 students (3 in a bench):

• Cadence/Tanner/equivalent EDA Tools -10 User License

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Behzad Razavi, “Design Of Analog Cmos Integrated Circuits”, Tata Mcgraw Hill, 2001.(Unit –I,II,III,IV)
2.	Parag K.Lala, “An Introduction to Logic Circuit Testing”,Morgan & Claypool Publishers,2009.(Unit V)

REFERENCE BOOKS

1.	Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006
2.	Grebene, “Bipolar And Mos Analog Integrated Circuit Design”, John Wiley & Sons,Inc.,2003. Phillip E.Allen, Douglas R .Holberg, “Cmos Analog Circuit Design”, Oxford University Press, 2nd Edition, 2002
3.	Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start
4.	Jacob Baker “CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

SIGNAL PROCESSING

Course Code	Course Title	L	T	P	J	C
22ECE007	ADVANCED DIGITAL SIGNAL PROCESSING	2	0	2	0	3
		Syllabus version			v. 1.0	
COURSE OBJECTIVES:						

1. To introduce the concepts of discrete time random signal processing
2. To know about multirate signal processing and its applications
3. To understand the spectrum estimation techniques
4. To learn the concept of prediction theory and filtering

COURSE OUTCOME:

1. Comprehend multirate signal processing and demonstrate its applications
2. Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems
3. Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
4. Analyze adaptive filtering problems and demonstrate its application
5. Apply power spectrum estimation techniques to random signals.

UNIT-1	MULTIRATE SIGNAL PROCESSING	6 HOURS

Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.

UNIT-2	DISCRETE TIME RANDOM PROCESSES	6 HOURS

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT-3	LINEAR PREDICTION AND FILTERING	6 HOURS

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT-4	ADAPTIVE FILTERING	6 HOURS

FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT-5	SPECTRUM ESTIMATION	6 HOURS

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.

	TOTAL LECTURE HOURS:	30 HOURS

PRACTICAL EXERCISES: **30 PERIODS**

1. Study of autocorrelation and Cross Correlation of random signals
2. Design and Implementation of Multirate Systems.
3. Design and Implementation of Wiener Filter
4. Design and Implementation of FIR Linear Predictor
5. Design of adaptive filters using LMS algorithm
6. Spectrum Estimation using Bartlett and Welch Methods

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2.	P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993

REFERENCE BOOKS

1.	Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2.	Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3.	Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw Hill, 2000.

Course Code	Course Title	L	T	P	J	C
22ECE008	IMAGE PROCESSING	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1.To become familiar with digital image fundamentals

2.To get exposed to simple image enhancement techniques in Spatial and Frequency domain.

3.To learn concepts of degradation function and restoration techniques.

4.To study the image segmentation and representation techniques.

5.To become familiar with image compression and recognition methods

COURSE OUTCOME:

1.Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

2. Operate on images using the techniques of smoothing, sharpening and enhancement.

3.Understand the restoration concepts and filtering techniques

4. Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

5.Comprehend image compression concepts		
UNIT-1	**DIGITAL IMAGE FUNDAMENTALS**	**9 HOURS**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.		
UNIT-2	**IMAGE ENHANCEMENT**	**9 HOURS**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.		
UNIT-3	**IMAGE RESTORATION**	**9 HOURS**
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering		
UNIT-4	**IMAGE SEGMENTATION**	**9 HOURS**
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		
UNIT-5	**IMAGE COMPRESSION AND RECOGNITION**	**9 HOURS**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition,2010.
2.	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCE BOOKS

1.	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2.	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3.	D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4.	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002 .

Course Code	Course Title	L	T	P	J	C
22ECE009	SPEECH PROCESSING	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Study the fundamentals of speech signal and extract various speech features
2. Understand different speech coding techniques for speech compression applications
3. Learn to build speech enhancement, text-to-speech synthesis system

COURSE OUTCOME:

1. Understand the fundamentals of speech.
2. Extract various speech features for speech related applications
3. Choose an appropriate speech coder for a given application.
4. Build a speech enhancement system.
5. Build a text-to-speech synthesis system for various applications

UNIT-1	FUNDAMENTALS OF SPEECH	6 HOURS

The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.

UNIT-2	SPEECH FEATURES AND DISTORTION MEASURES	6 HOURS

Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.

UNIT-3	SPEECH CODING	6 HOURS

Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech

UNIT-4	SPEECH ENHANCEMENT	6 HOURS

Classes of Speech Enhancement Algorithms, Spectral-Subtractive Algorithms - Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, Wiener Filtering - Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, Subspace Algorithms.

UNIT-5	**SPEECH SYNTHESIS AND APPLICATION**	**6 HOURS**

A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.

TOTAL LECTURE HOURS: 30 HOURS

PRACTICAL EXERCISES: 30 PERIODS

1. Write a MATLAB Program to classify voiced and unvoiced segment of speech using various time domain measures
2. Write a MATLAB Program to calculate the MFCC for a speech signal
3. Implement ITU-T G.722 Speech encoder in MATLAB
4. Write a MATLAB Program to implement Wiener Filters for Noise Reduction
5. Design a speech emotion recognition system using DCT and WPT in MATLAB

HARDWARE & SOFTWARE SUPPORT TOOLS:

- Personal Computer with MATLAB
- Microphone and Speakers

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
2.	Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013

REFERENCE BOOKS

1.	Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003
2.	Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE010	**SOFTWARE DEFINED RADIO**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the concepts of software radios
2. To know about RF implementation challenges for software defined radios
3. To understand the digital generation of signals
4. To learn the software and hardware requirements for software defined radios.

COURSE OUTCOME:

1. Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation.
2. Analyse Radio frequency implementation issues
3. Implement Smart antenna techniques for software defined radio.
4. Compare various digital synthesis procedures.
5. Comprehend various hardware and software requirements for software defined radios.

UNIT-1	**INTRODUCTION TO SOFTWARE RADIO**	**6 HOURS**

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio

UNIT-2	**RF IMPLEMENTATION**	**6 HOURS**

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

UNIT-3	**DIGITAL GENERATION OF SIGNALS**	**6 HOURS**

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT-4	**SMART ANTENNAS**	**6 HOURS**

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT-5	**HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES**	**6 HOURS**

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Study of SDR hardware kit
2. Design and Implementation of digital modulation schemes using SDR

3. Implementation of synchronization techniques using SDR 4. Channel Coding Techniques using SDR 5. Study of channel estimation techniques using SDR 6. Study of MIMO concepts using SDR **TOTAL CONTACT HOURS: 60**

TEXT BOOK(S)	
1.	1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering,” Prentice Hall Professional, 2002.
2.	Tony J Rouphael, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.
REFERENCE BOOKS	
1.	P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House, 2005. 2. Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002. 3. Behrouz. F. Bourjney“ Signal Processing for Software defined Radios”, Lulu 2008.
2.	D. K. Misra, “Radio Frequency and Microwave Communication Circuits”- Analysis and Design, John Wiley & Sons, 2004.
3.	W.Alan Davis, Krishna Agarwal, “Radio Frequency Circuit Design”, John willy & Sons,2001.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE011	**DSP ARCHITECTURE AND PROGRAMMING**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. Study the architecture of programmable DSP processors
2. Learn to implement various standard DSP algorithms in DSP Processors
3. Use the Programmable DSP Processors to build real-time DSP systems

COURSE OUTCOME:

1. Understand the architectural features of DSP Processors.
2. Comprehend the organization of TMS320C54xx DSP processors
3. Build solutions using TMS320C6x DSP Processor
4. Implement DSP Algorithms
5. Study the applications of DSP Processors.

UNIT-1	**ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS**	**6 HOURS**

Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing

UNIT-2	**TMS320C5X PROGRAMMABLE DSP PROCESSOR**	**6 HOURS**
Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit		
UNIT-3	**TMS320C6X PROGRAMMABLE DSP PROCESSOR**	**6 HOURS**
Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools		
UNIT-4	**IMPLEMENTATION OF DSP ALGORITHMS**	**6 HOURS**
DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.		
UNIT-5	**APPLICATIONS OF DSP PROCESSORS**	**6 HOURS**
Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition.		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Real-Time Sine Wave Generation
2. Programming examples using C, Assembly and linear assembly
3. Implementation of moving average filter
4. FIR implementation with a Pseudorandom noise sequence as input to a filter
5. Fixed point implementation of IIR filter
6. FFT of Real-Time input signal

HARDWARE & SOFTWARE SUPPORT TOOLS:

- TMS320C54xx/TMS320C67xx DSP Development board
- Code Composer Studio (CCS)
- Function Generator and Digital Storage Oscilloscope
- Microphone and speaker

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012
2.	RulphChassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008

REFERENCE BOOKS	
1.	B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2.	TMS320C5416/6713 DSK user manual at https://www.ti.com

Course Code	Course Title	L	T	P	J	C
22ADE006	COMPUTER VISION	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To understand the fundamental concepts related to Image formation and processing.
2. To learn feature detection, matching and detection
3. To become familiar with feature-based alignment and motion estimation
4. To develop skills on 3D reconstruction
5. To understand image based rendering and recognition

COURSE OUTCOME:

1. To understand the fundamental concepts related to Image formation and processing.
2. To learn feature detection, matching and detection
3. To become familiar with feature based alignment and motion estimation
4. To develop skills on 3D reconstruction
5. To understand image based rendering and recognition

UNIT-1	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6 HOURS

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-2	FEATURE DETECTION, MATCHING AND SEGMENTATION	6 HOURS

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-3	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	6 HOURS

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT-4	3D RECONSTRUCTION	6 HOURS

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT-5	IMAGE-BASED RENDERING AND RECOGNITION	6 HOURS

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL LECTURE HOURS: 30 HOURS

PRACTICAL EXERCISES: 30 PERIODS

LABORATORY EXPERIMENTS:

Software needed:
OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or equivalent

1. OpenCV Installation and working with Python
2.Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3.Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4.Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5.Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
6.Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8.Pose Estimation
9.3D Reconstruction – Creating Depth map from stereo images
10.Object Detection and Tracking using Kalman Filter, Camshift

1. docs.opencv.org
2. https://opencv.org/opencv-free-course/

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2.	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCE BOOKS

1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision,

	Second Edition, Cambridge University Press, March 2004
2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

RF TECHNOLOGIES

Course Code	Course Title	L	T	P	J	C
22ECE013	RF TRANSCEIVERS	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To understand the fundamentals of RF system design
2. To acquaint with the various components of RF system for wireless communications
3. To know the basic techniques needed for analysis of RF systems
4. To enable the students to verify the basic principles and design aspects involved in RF systems components
5. To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts

COURSE OUTCOME:

1. Interpret the nonlinear effects in RF circuits
2. Design RF circuits
3. Analyze the performance of RF circuits
4. Apply knowledge to identify a suitable architecture and systematically design an RF System
5. Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions

UNIT-1	CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES	6 HOURS

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes

UNIT-2	IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS	6 HOURS

Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs		
UNIT-3	**FEEDBACK SYSTEMS AND POWER AMPLIFIERS**	**6 HOURS**
Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric		
UNIT-4	**FILTERS, OSCILLATORS AND MIXERS**	**6 HOURS**
Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator – basic characteristics of mixers, single and double-balanced mixers		
UNIT-5	**PLL AND FREQUENCY SYNTHESIZERS**	**6 HOURS**
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps-Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Measurement of S-parameters for impedance matching circuits, and RF filters using network analyzer
2. Design of RF inductor and capacitor
3. Design and characterization of LNA
4. Design of impedance matching network
5. Design of low-pass and band-pass filter at RF
6. Design and characterization of mixer

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004
2.	Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012

REFERENCE BOOKS

1.	Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall,2000
2.	Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3.	Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015

Course Code	Course Title	L	T	P	J	C
22ECE014	ELECTROMAGNETICS FOR COMMUNICATIONS	3	0	0	0	3
		Syllabus			v. 1.0	

		version	

COURSE OBJECTIVES:

1. To revise of basics of Electromagnetic theory and understand its importance in communication systems.
2. To acquire knowledge on the EMI mechanisms
3. To impart concepts of Electromagnetic compatibility schemes
4. To understand the importance of EM wave propagation in communication
5. To know about the basics of light wave and Radar systems

COURSE OUTCOME:

1. Understand the importance of EM theory for communication
2. Identify EMI in circuits and systems
3. Use appropriate EM compatibility schemes in electronic systems
4. Model wireless channels for communications
5. Apply knowledge light wave and RADAR system design.

UNIT-1	**FUNDAMENTALS OF ELECTROMAGNETIC THEORY**	**9 HOURS**

Electric and magnetic fields; Maxwell‟s equations in integral and Differential forms, Boundary conditions; Poynting's vector and energy storage; Static fields and circuit elements; Quasi-static fields and frequency behaviour of circuit elements.

UNIT-2	**ELECTROMAGNETIC INTERFERENCE**	**9 HOURS**

Electromagnetic Environment, Practical concerns, Frequency spectrum conservation, Sources of EMI: Lightning, ESD, EMP, EMI from apparatus and circuits. Modeling of Interferences, Test sites and measurements, Simulation of EMI.

UNIT-3	**ELECTROMAGNETIC COMPATIBILITY**	**9 HOURS**

Capacitive and inductive couplings; Crosstalk on transmission lines; Common impedance coupling; Methods of solution of EMC problems; EMI filters, Grounding and Shielding; Cables and connectors, EMC standards.

UNIT-4	**ELECTROMAGNETIC WAVE PROPAGATION**	**9 HOURS**

EM Waves and Radiation. Overview of propagation effects; Ground wave, Sky wave, Tropospheric, Ionospheric propagation effects; Propagation models for satellite and Mobile links.EM Simulation of propagation models.

UNIT-5	**ELECTROMAGNETICS FOR LIGHTWAVE AND RADAR**	**9 HOURS**

	SYSTEMS	
Reflection, refraction, Interference and diffraction of plane waves; Dielectric slab waveguide; Pulse broadening in a dispersive medium. RADAR, LIDAR range equations, Radar cross section (RCS). Introduction to electromagnetic field computation and simulation.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	N.N.Rao, "Fundamentals of Electromagnetics for Engineering", Pearson Education, 2008.	
2.	Henry Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons, 2011.	
3.	Abdollah Gasemi, Ali Abedi, Farshid Gashemi, "Propagation Engineering in Wireless Communication". Springer Verlag, Newyork, 2016.	
REFERENCE BOOKS		
1.	Clayton Paul," Introduction to Electromagnetic compatibility", Wiley Interscicne,2nd edition,2006.	
2.	G. Keiser, "Optical Fiber Communications", 5 Edition, Tata McGraw-Hill, New Delhi, 2013.	
3.	Michael. O. Kolawole, "Radar Systems, Peak Detection and Tracking", Elsevier,Burlington, 2006.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE015	**ANTENNA DESIGN**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the basic concepts of antenna arrays for smart antenna design
2. To discuss the random variables and processes for angle of arrival (AOA) estimation
3. To describe different algorithms used for AOA estimation
4. To introduce the concepts of fixed weight beamforming
5. To introduce the concept of adaptive beamforming

COURSE OUTCOME:

1. Describe the basics of phased array antennas
2. Understand random process and its application in Smart antennas
3. Estimate the weights of the antenna array based on the angle of arrival
4. Analyze the fixed weight beamforming in smart antennas

5. Analyze adaptive beamforming in smart antennas

UNIT-1	ANTENNA ARRAY FUNDAMENTALS	6 HOURS

Linear arrays: Two element and Uniform N element array – Array weighting: Beam steered and weighted arrays – Circular arrays – Rectangular planar arrays – Fixed beam arrays – Butler Matrices – Fixed side lobe cancelling – Retro directive arrays: Passive and active retro directive arrays.

UNIT-2	PRINCIPLES OF RANDOM VARIABLES AND PROCESSES	6 HOURS

Definition of Random Variables - Probability Density Functions - Expectation and Moment - Common Probability Density Functions - Stationarity and Ergodicity - Autocorrelation and Power Spectral Density - Correlation Matrix

UNIT-3	ANGLE OF ARRIVAL ESTIMATION	6 HOURS

Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix - AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate, Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate

UNIT-4	SMART ANTENNAS: FIXED WEIGHT BEAMFORMING	6 HOURS

Introduction - Historical Development of Smart Antennas - Fixed Weight Beamforming Basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance

UNIT-5	SMART ANTENNAS: ADAPTIVE BEAMFORMING	6 HOURS

Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method, Spreading sequence array weights, Description of the new SDMA receiver.

TOTAL LECTURE HOURS:	30 HOURS

PRACTICAL EXERCISES: **30 PERIODS**

1. Write a MATLAB code to estimate the radiation pattern of a linear array and N element uniform array
2. Write a MATLAB code to estimate the AOA using MUSIC and ESPRIT algorithm
3. Write a MATLAB code to estimate the weights of the array. Using the final weights estimate the array factor and the mean square error.
4. Write a MATLAB code to dynamically alter the main lobe direction based on the information of AOA.

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2006.
2.	S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2009.

REFERENCE BOOKS	
1.	T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 1998.
2.	Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011.
3.	Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005

Course Code	Course Title	L	T	P	J	C
22ECE016	MICS AND RF SYSTEM DESIGN	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To study the characteristics of Active components and applications.
2. To design the RF filter and analyze the circuits operated at millimeter wavelength
3. To understand the basics of Microwave integrated circuits
4. To learn the concepts of non reciprocal components for MICs
5. To design the antenna and analyze its performance using measurement techniques

COURSE OUTCOME:

1. Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure.
2. Analyze microwave circuits for filters design.
3. Evaluate the performance of any practical Microwave integrated circuits
4. Create communication circuits and subsystems with practical design parameters fornonreciprocal components in MICs.
5. Design microwave integrated antenna design circuit for the required Performance using professional software tools.

UNIT-1	ACTIVE RF COMPONENTS AND APPLICATIONS	6 HOURS

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networksimpedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

UNIT-2	RF FILTER DESIGN	6 HOURS

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter

UNIT-3	INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS	6 HOURS

Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstripline- Active Device Technologies- Design Approaches Multichip Module Technology- Substrates		
UNIT-4	**NON RECIPROCAL COMPONENTS FOR MICs**	**6 HOURS**
Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.		
UNIT-5	**INTEGRATED ANTENNA DESIGN AND MEASUREMENTS**	**6 HOURS**
Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements - Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Design of low pass, high pass, band pass and band stop filter at RF using any software tool
2. Design of low pass, high pass, band pass and band stop filter at RFDesign of low pass, high pass, band pass and band stop filter at RF
3. Design of low pass, high pass, band pass and band stop filter at RF
4. Design of low pass, high pass, band pass and band stop filter at RF
5. Measurement of S parameters for a) Inductor b) Capacitor c) impedance matching circuits, filters using network analyzer
6. Design a microstrip circuits

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.(Unit – I, II)
2.	Bharathi Bhat, Shiban K. Koul, “Stripline-like Transmission Lines for Microwave Integrated Circuits”, New Age International Pvt Ltd Publishers, 2007.(Unit –III ,V)
3.	Gupta KC and Amarjit Singh, “Microwave Integrated circuits”, Wiley Eastern, 1974.(Unit – IV)

REFERENCE BOOKS

1.	MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
2.	Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000
3.	RolandE. Best, Phase – Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003
4.	David Pozar ,Microwave Engineering, Addison Wesley 3rd Edition
5.	Ravender Goyal, “Monolithic MIC; Technology & Design”, Artech House, First Edition 1989

Course Code	Course Title	L	T	P	J	C

22ECE017	EMI / EMC PRE COMPLIANCE TESTING	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To introduce the basic concepts of Electromagnetic Interference
2. To teach the importance of measurement device for EMI.
3. To explain the EMI coupling & control principles
4. To understand receivers & Analyzer functionalities
5. To impart knowledge on design issues in EMI/EMC

COURSE OUTCOME:

1. Perceive the various types and mechanisms of Electromagnetic Interference
2. Propose a suitable EMI mitigation technique.
3. Evaluate EMI coupling & control principles
4. Explain the importance receivers & Analyzer functionalities
5. Inspect the design issues in EMI/EMC

UNIT-1	NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY	6 HOURS

Introduction-Visualisiong the EMI problem-Source of EMI,EMI coupling to victim equipment, Intersystem and Intrasystem EMI, EMC standards and specifications

UNIT-2	TYPES of EMI COUPLING	6 HOURS

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI

UNIT-3	MEASUREMENT DEVICES FOR EMI	6 HOURS

Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas – Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing

UNIT-4	RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT	6 HOURS

EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge

UNIT-5	PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS	6 HOURS
Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC - Developing an approach to EMC design - Process flow chart, - EMC strategy – Self certification; Solutions to avoid EMC: ESD Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.		
	TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Basic spectrum measurement and power measurement with markers
2. Perform environment scan and detect various signals available
3. DPX, Spectrogram and transient capture with mask test and act on violation
4. EMI spurious detection and measurement against EMI limit lines
5. Use of LISN and measurement concept of Conducted emission

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012
2.	Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017

REFERENCE BOOKS

1.	1.V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996
2.	2. Paul, C.R., “Introduction to Electromagnetic Compatibility”, 2nd ed., Wiley (2010)
3.	3. David K. Cheng, “Field and Wave Electromagnetics”, 2nd ed. Pearson Education, 2009

Course Code	Course Title	L	T	P	J	C
22ECE018	RFID SYSTEM DESIGN AND TESTING	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To discuss the fundamentals of near field and far field RFID communications
2. To articulate the standards and protocols used in RFID systems
3. To describe the operating principles of RFID tag and reader
4. To introduce the security aspects and system architecture of RFID systems
5. To illustrate the industrial and scientific applications of RFID systems

COURSE OUTCOME:

1. Classify RFID systems based on frequency, architecture and performance
2. Define standards for RFID technology

3. Illustrate the operation of various components of RFID systems
4. Describe the privacy and security issues in RFID Systems
5. Discuss the construction and applications of RFID enabled sensor

UNIT-1	INTRODUCTION	6 HOURS

RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Frequency based property comparison of RFID Systems

UNIT-2	RFID STANDARDS AND PROTOCOLS	6 HOURS

RFID Industry standards: EPC global – ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol

UNIT-3	OPERATING PRINCIPLES	6 HOURS

RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication.

UNIT-4	DATA INTEGRITY AND SECURITY	6 HOURS

The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures

UNIT-5	RFID ENABLED SENSORS AND APPLICATIONS	6 HOURS

RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget, Applications: Contactless smart cards – Access control – Electronic passport – Industrial Automation – Medical applications – Challenges and opportunities.

TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES: **30 PERIODS**

1. Design of a passive RFID Tag Antenna
2. Design of an RFID reader antenna
3. Determination of read range of the RFID tag at UHF and Microwave frequencies
4. Determination of RFID tag performance for different standards

TOTAL CONTACT HOURS: 60

TEXT BOOK(S)

1.	Roy Want, RFID Explained, Springer 2022.
2.	Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010

REFERENCE BOOKS

1.	Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010
2.	Syed Ahson, Mohammad Ilyas, RFID Handbook, CRC Press, 2008
3.	Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.

BIO MEDICAL TECHNOLOGIES

COURSE CODE	COURSE TITLE	L	T	P	J	C
22BME032	WEARABLE DEVICES	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

The student should be made to:

1. To know the hardware requirement of wearable systems
2. To understand the communication and security aspects in the wearable devices
3. To know the applications of wearable devices in the field of medicine

COURSE OUTCOME:

On successful completion of this course, the student will be able to

1. Describe the concepts of wearable system.
2. Explain the energy harvestings in wearable device.
3. Use the concepts of BAN in health care.
4. Illustrate the concept of smart textile
5. Compare the various wearable devices in healthcare system

UNIT-1	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	9 HOURS

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT-2	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES	9 HOURS

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT-3	WIRELESS HEALTH SYSTEMS	9 HOURS

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT-4	SMART TEXTILE	9 HOURS

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks.Case study-smart

fabric for monitoring biological parameters - ECG, respiration.		
UNIT-5	**APPLICATIONS OF WEARABLE SYSTEMS**	**9 HOURS**
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1.	Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2.	Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3.	Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4.	Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS:

1.	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2.	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**J**	**C**
22BME039	**HUMAN ASSIST DEVICES**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			**v. 1.0**	

COURSE OBJECTIVES:

1. To study the role and importance of machines that takes over the functions of the heart and lungs,
2. To study various mechanical techniques that help a non-functioning heart
3. To learn the functioning of the unit which does the clearance of urea from the blood
4. To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
5. To study about recent techniques used in modern clinical applications

COURSE OUTCOME:

1. At the end of this course the students will be able to:
2. Explain the principles and construction of artificial heart
3. Understand various mechanical techniques that improve therapeutic technology
4. Explain the functioning of the membrane or filter that cleanses the blood.
5. Describe the tests to assess the hearing loss and development of wearable devices for the same.
6. Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

UNIT-1	**HEART LUNG MACHINE AND ARTIFICIAL HEART**	**9 HOURS**
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for		

temporary bypass of left ventricle.		
UNIT-2	**CARDIAC ASSIST DEVICES**	**9 HOURS**
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.		
UNIT-3	**ARTIFICIAL KIDNEY**	**9 HOURS**
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.		
UNIT-4	**RESPIRATORY AND HEARING AIDS**	**9 HOURS**
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.		
UNIT-5	**RECENT TRENDS**	**9 HOURS**
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOKS:

1.	Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2.	John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3.	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCE BOOKS:

1.	Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.
2.	Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**J**	**C**
22ECE019	**THERAPEUTIC EQUIPMENT**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			**v. 1.0**	

COURSE OBJECTIVES:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

COURSE OUTCOME:

CO1: Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc
CO2: Comprehend the principles of bodycare equipment
CO3: Understand the operation of dental care equipment.
CO4: Analyze the different types of therapies for suitable applications.
CO5: Appreciate the application of lasers in biomedical applications.

UNIT-1	**CARDIAC AND RESPIRATORY THERAPY EQUIPMENT**	**9 HOURS**

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter.

Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.

UNIT-2	**BIOMECHANICAL THERAPEUTIC EQUIPMENT**	**9 HOURS**

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT-3	**BODY CARE EQUIPMENT**	**9 HOURS**

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.

UNIT-4	**DENTAL CARE EQUIPMENT**	**9 HOURS**

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum tecniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT-5	**HEAT & PHOTON THERAPY EQUIPMENT**	**9 HOURS**

High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.

	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.
2. John.G.Webster. “Medical Instrumentation, Application and Design”. Fourth Edition.Wiley & sons, Inc., NewYork. 2009.

REFERENCE BOOKS:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. “Biomedical Instrumentation and Measurements”. Second Edition. Prentice Hall Inc.2000.
2. John Low & Ann Reed. “Electrotherapy Explained, Principles and Practice”. Second Edition. Butterworth Heinemann Ltd. 2000.

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**J**	**C**

22BME028	MEDICAL IMAGING SYSTEMS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To understand the generation of X-ray and its uses in Medical imaging
- To describe the principle of Computed Tomography
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety

COURSE OUTCOME:

CO1: Describe the working principle of the X-ray machine and its application.
CO2: Illustrate the principle computed tomography
CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.
CO4: Demonstrate the applications of radionuclide imaging.
CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

UNIT-1	X RAYS	9 HOURS

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT-2	COMPUTED TOMOGRAPHY	9 HOURS

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT-3	MAGNETIC RESONANCE IMAGING	9 HOURS

Fundamentals of magnetic resonance- properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT-4	NUCLEAR IMAGING	9 HOURS

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET

UNIT-5	RADIATION THERAPY AND RADIATION SAFETY	9 HOURS

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles

	TOTAL LECTURE HOURS:	45 HOURS

TEXT BOOK(S):

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000

2.	Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000
3.	Khin Wee Lai, Dyah Ekashanti Octorina Dewi “Medical Imaging Technology”, Springer Singapore, 2015
REFERENCE BOOKS:	
1.	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.
2.	Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “,Springer-Verlag New York, 2011

COURSE CODE	COURSE TITLE	L	T	P	J	C
22BME029	BRAIN COMPUTER INTERFACE AND APPLICATIONS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

The student should be made to:

- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

COURSE OUTCOME:

CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications

UNIT-1	**INTRODUCTION TO BCI**	**9 HOURS**

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT-2	**ELECTROPHYSIOLOGICAL SOURCES**	**9 HOURS**

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 -Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT-3	**FEATURE EXTRACTION METHODS**	**9 HOURS**

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features

UNIT-4	**FEATURE EXTRACTION METHODS**	**9 HOURS**

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT-5	**APPLICATIONS OF BCI**	**9 HOURS**

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1.	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010
REFERENCE BOOKS:	
1.	R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2.	Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.

COURSE CODE	COURSE TITLE	L	T	P	J	C
22BME034	BODY AREA NETWORKS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

COURSE OUTCOME:

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Design a BAN for appropriate application in medicine.
CO3: Assess the efficiency of communication and the security parameters.
CO4: Understand the need for medical device regulation and regulations followed in various regions
CO5: Extend the concepts of BAN for medical applications.

UNIT-1	INTRODUCTION	9 HOURS

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT-2	HARDWARE FOR BAN	9 HOURS

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT-3	WIRELESS COMMUNICATION AND NETWORK	9 HOURS

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT-4	COEXISTENCE ISSUES WITH BAN	9 HOURS

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT-5	APPLICATIONS OF BAN	9 HOURS

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

		TOTAL LECTURE HOURS: **45 HOURS**
TEXT BOOK(S):		
1.	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013	
2.	Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012	
REFERENCE BOOKS:		
1.	Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.	
2.	Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.	

SENSOR TECHNOLOGIES AND IOT

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE020	**IoT Processors**	**2**	**0**	**2**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Learn the architecture and features of ARM.
2. Study the exception handling and interrupts in CORTEX M3
3. Program the CORTEX M3
4. Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
5. Understand the concepts of System – On – Chip (SoC)

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Explain the architecture and features of ARM.
CO2: List the concepts of exception handling.
CO3: Learn the architecture of ARM CORTEX M3/M4.
CO4: Learn the architecture of STM32L15XXX.
CO5: Design an SoC for any application.

UNIT-1	**OVERVIEW OF ARM AND CORTEX-M3**	**6 HOURS**

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.

UNIT-2	**CORTEX EXCEPTION HANDLING AND INTERRUPTS**	**6 HOURS**

Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

UNIT-3	CORTEX M3/M4 PROGRAMMING	6 HOURS

ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools Cross Assembler, mCompiler, Debugger.

UNIT-4	STM32L15XXX ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS	6 HOURS

STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assembler, mCompiler, Debugger, Simulator, In – Circuit Emulator(ICE), Logic Analyser.

UNIT-5	INTRODUCTION TO SYSTEM – ON – CHIP	6 HOURS

System Architecture: An Overview, Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.

TOTAL LECTURE HOURS:	**30 HOURS**
PRACTICAL EXERCISES:	**30 HOURS**

ARM Assembly Programming

1. Write a program to add two 32-bit numbers stored in r0 and r1 registers and write the result to r2. The result is stored to a memory location. a) Run the program with breakpoint and verify the result b) Run the program with stepping and verify the content of registers at each stage.
2. Write ARM assembly to perform the function of division. Registers r1 and r2 contain the dividend and divisor, r3 contains the quotient, and r5 contains the remainder.

Embedded C Programming on ARM Cortex M3/M4 Microcontroller

1. Write a program to turn on green LED (Port B.6) and Blue LED (Port B.7) on STM32L-Discovery by configuring GPIO.
2. Transmit a string “Programming with ARM Cortex” to PC by configuring the registers of USART2. Use polling method.

ARM Cortex M3/M4 Programming with CMSIS

1. Write a program to toggle the LEDs at the rate of 1 sec using standard peripheral library. Use Timer3 for Delay.
2. Transmit a string “Programming with ARM Cortex” to PC by using standard peripheral library with the help of USART3. Use polling method.

TOTAL LECTURE HOURS:	**60 PERIODS**

TEXT BOOK(S)

1.	Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010.(Unit – I, II)
2.	Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV)
3.	Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011.(Unit – V)

REFERENCE BOOKS

1.	Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015.
2.	CORTEX M Series ARM Reference Manual
3.	CORTEX M3 Technical Reference Manual
4.	STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97

Course Code	Course Title	L	T	P	J	C
22ECE021	IOT BASED SYSTEMS DESIGN	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To understand the basics of IoT.
2. To get knowledge about the various services provided by IoT.
3. To familiarize themselves with various communication techniques and networking.
4. To know the implementation of IoT with different tools.
5. To understand the various applications in IoT.

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Explain the architecture and features of ARM.
CO2: List the concepts of exception handling.
CO3: Learn the architecture of ARM CORTEX M3/M4.
CO4: Learn the architecture of STM32L15XXX.
CO5: Design an SoC for any application.

UNIT-1	INTRODUCTION TO INTERNET OF THINGS	9 HOURS

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications.

UNIT-2	MIDDLEWARE AND PROTOCOLS OF IOT	9 HOURS

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX, BACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware (Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT-3	COMMUNICATION AND NETWORKING	9 HOURS
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.		
UNIT-4	**IOT IMPLEMENTATION TOOLS**	**9 HOURS**
Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.		
UNIT-5	**APPLICATIONS AND CASE STUDIES**	**9 HOURS**
Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.	
2.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.	
REFERENCE BOOKS		
1.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.	
2.	Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.	
3.	Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.	

Course Code	Course Title	L	T	P	J	C
22ECE022	WIRELESS SENSOR NETWORK DESIGN	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To understand the fundamentals of wireless sensor network
2. To gain knowledge on the MAC and Routing Protocols of WSN
3. To get exposed to 6LOWPAN technology
4. To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
5. To gain knowledge about operating system related to WSN and 6LOWPAN

COURSE OUTCOME:		
Upon completion of the course, the students will be able to **CO1**: To be able to design solutions for WSNs applications **CO2**: To be able to develop efficient MAC and Routing Protocols **CO3**: To be able to design solutions for 6LOWPAN applications **CO4**: To be able to develop efficient layered protocols in 6LoWPAN **CO5**: To be able to use Tiny OS and Contiki OS in WSNs and 6LoWPAN applications		
UNIT-1	**INTRODUCTION**	**9 HOURS**
Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.		
UNIT-2	**MAC AND ROUTING PROTOCOLS**	**9 HOURS**
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.		
UNIT-3	**6LOWPAN**	**9 HOURS**
6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh- Under - Route-Over, Header Compression - Stateless header compression - Context-based header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.		
UNIT-4	**APPLICATION**	**9 HOURS**
Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.		
UNIT-5	**TOOLS**	**9 HOURS**
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Holger Karl, Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.	
2.	Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.	
3.	Zach Shelby Sensinode and Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009.	
REFERENCE BOOKS		
1.	Philip Levis, “TinyOS Programming”, 2006 – www.tinyos.net.	

2.	The Contiki Operating System. http://www.sics.se/contiki.

Course Code	Course Title	L	T	P	J	C
22ECE023	INDUSTRIAL IOT AND INDUSTRY 4.0	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. IoT Nodes & Sensors
2. IoT Gateways
3. IoT Cloud Systems
4. IoT Cloud Dashboards
5. Challenges in Iot system Design – Hardware & Software

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications

CO2: Use processors & peripherals to design & build IoT hardware

CO3: Assess, select and customize technologies for IoT applications

CO4: Connect numerous IOT applications with the physical world of humans and real life problem solving.

CO5: Design and implement IOT applications that manage big data

UNIT-1	UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM	6 HOURS

IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics

UNIT-2	COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM	6 HOURS

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.

UNIT-3	IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS	6 HOURS

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors;

Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors,Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with

ultrasound sensor.

UNIT-4	IOT DEVELOPMENT PLATFORM	6 HOURS

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services.

UNIT-5	IOT SYSTEM DESIGN – HARDWARE & SOFTWARE	6 HOURS

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.

TOTAL LECTURE HOURS:	**30 HOURS**

PRACTICAL EXERCISES:

1. Study and Program different Sensors for IoT applications

- LDR sensor, IR sensor, Temperature Sensor, Ultrasound Sensor, Gas sensor
- Write a program using IR sensor for working morning alarm and night lamp
- Write a program using sensors for water level indicator and overflow detection

2. Designing and debugging complex mixed signal devices (analog, digital, and RF)

- Write a program to control LEDs using Alexa Echo Dot.
- Write a program to control Buzzer using Alexa Echo Dot.
- Write a program to control Stepper motor using Google Assistance

3. Understanding battery requirements

- Determining ultra-low deep sleep current of Node
- Measuring Transmit and Receive current signals of Node
- Capturing short transients and fast transients signals of node

4. Understanding Modulation techniques –

- Understanding of ASK, FSK Modulation and measurements
- Capturing the live ASK Signal and decoding it.

TOTAL LECTURE HOURS:	**30 HOURS**
TOTAL LECTURE HOURS:	**60 HOURS**

TEXT BOOK(S)

1.	Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2.	Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCE BOOKS

1.	Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2.	N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3.	Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan

Course Code	Course Title	L	T	P	J	C
22ECE024	NETWORK SECURITY	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To learn the fundamentals of cryptography and its application to network security.
2. To understand the mathematics behind cryptography.
3. To learn about the principles and protocols that enables its application to wired and wireless networks.
4. To develop an understanding of security policies such as authentication, integrity and confidentiality as well as protocols to implement such policies.
5. To study about network security threats, security services, and counter measures.

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Design cryptographic algorithms and carry out their implementation.
CO2: Carry out cryptanalysis on cipher.
CO3: Design and implement security protocols.
CO4: Carry out system security for various threat environments.
CO5: Understand the importance of firewall security for network.

UNIT-1	INTRODUCTION TO CRYPTOGRAPHY	9 HOURS

Security Services and Mechanisms, Mathematics of symmetric cryptography and Asymmetric cryptography - Algebraic structures - GF(2n) Fields - Primes - Fermat's Theorem and Euler's Theorem - Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm.

UNIT-2	SYMMETRIC AND ASYMMETRIC CIPHERS	9 HOURS

Classical Techniques – Substitution Ciphers - Transposition Ciphers. Modern symmetric ciphers: Stream cipher - RC4, Block cipher - DES – AES – Uses of Modes of operation. Modern Asymmetric block ciphers - RSA, ElGamal.

UNIT-3	SECURITY TECHNIQUES	9 HOURS

Message Integrity – MAC – Cryptographic Hash Functions - SHA 512. Digital Signature Schemes - RSA, Elgamal. Entity Authentication - Passwords, Challenge Response. Key management system- Key Distribution & Key Agreements.

UNIT-4	SECURITY AT LAYERS	9 HOURS

Application Layer - EMail Security: PGP, S/MIME. Transport Layer: TLS, SSL. Network Layer - IPsec.

UNIT-5	**SYSTEM SECURITY**	**9 HOURS**
Intruders- Intrusion Detection , Malicious software - Types, viruses, countermeasures, worms. Firewalls - Need for firewalls, characteristics, types.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	Behrouz A. Ferouzan, Debdeep Mukhopadhyay —Cryptography & Network Security, 3rd edition, Tata McGraw Hill, 2015.
2.	William Stallings “Cryptography and Network Security: Principles and Practice”, 3rd Edition, Pearson Education, 2002.
REFERENCE BOOKS	
1.	David M. Durton, “Elementary Number Theory”, Tata Mcgraw Hill, Sixth Edition, 2009.
2.	Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography: Principles and Protocols (Chapman & Hall/CRC Cryptography and Network Security Series)", 1st Edition, CRC Press Taylor and Francis Group, 2008.
3.	Douglas R. Stinson, Cryptography: Theory and Practice, Third Edition (Discrete Mathematics and Its Applications), Chapman & Hall/CRC, 2005.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE025	**FUNDAMENTALS OF CLOUD COMPUTING**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Introduce the fundamentals of Cloud Computing and virtualization.
2. Familiarize various standards related to cloud computing.
3. Familiar with the lead players in cloud.
4. Understand various cloud services in cloud computing.
5. Install and use current cloud technologies

COURSE OUTCOME:

Upon completion of the course, the students will be able to

CO1: Build custom made clouds.
CO2: Develop remote access applications, alert generation using cloud.
CO3: Work with commercial cloud packages.
CO4: Identify core issues of cloud computing such as security.
CO5: Install and use current cloud technologies

UNIT-1	**INTRODUCTION TO CLOUD COMPUTING**	**9 HOURS**
Cloud Computing – History, Architecture, Storage, Advantages, Disadvantages, Services, Server Virtualization- Parallel Processing, Vector Processing, Symmetric Multiprocessing Systems and Massively Parallel Processing Systems.		
UNIT-2	**CLOUD BASED WEB SERVICES**	**9 HOURS**

Understanding Private and Public cloud environments - Communication as a Service (CaaS) - Infrastructure as a Service (IaaS) - On-demand, Amazon‟s Elastic, Amazon EC2, Mosso - Monitoring as a Service (MaaS) - Platform as a Service (PaaS) – On-Premises model, new cloud model - Software as a Service (SaaS) –implementation issues, characteristics, SaaS model.		
UNIT-3	**CLOUD COMPUTING FOR EVERYONE**	**9 HOURS**
Centralizing Email Communications - Collaborating on Schedules - Collaborating on To-Do Lists - Collaborating Contact Lists - Cloud Computing for the Community - Collaborating on Group Projects and Events - Cloud Computing for the Corporation		
UNIT-4	**CLOUD SERVICES**	**9 HOURS**
Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing - Collaborating on Databases – Storing and Sharing Files		
UNIT-5	**FUTURE DIRECTIONS TO CLOUD**	**9 HOURS**
Cloud Security – Software as a Service Security – Standards for application developers –Ajax, XML, JSON, LAMP, LAPP –Standards for Messaging –SMTP, POP, IMAP, HTTP, SIMPLE, XMPP – Standards for Security –SAML oAuth, OpenID, SSL/TLS, Collaborating via Blogs and Wikis – Mobile Platform Virtualization –KVM, VMWare.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	John W.Ritting house and James F.Ransome, “Cloud Computing – Implementation, Management and Security", CRC press, 2012.	
2.	Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Pearson, 2008.	
REFERENCE BOOKS		
1.	Barrie Sosinsky, “Cloud Computing –Bible”, Wiley Indian Edition, 2011.	
2.	Anthony T Velte, Toby J Velte, Robert Elsenpeter, Cloud Computing : A Practical Approach, Tata McGraw-Hill 2010.	
3.	David E.Y. Sarna Implementing and Developing Cloud Application, CRC press 2011.	

Course Code	Course Title	L	T	P	J	C
22ECE026	OPTICAL COMMUNICATION AND NETWORKS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To Study About The Various Optical Fiber Modes, Configuration Of Optical Fibers
2. To Study Transmission Characteristics Of Optical Fibers.
3. To Learn About The Various Optical Sources, Detectors And Transmission Techniques
4. To study about the optical network components and its uses
5. To Enrich The Knowledge About Optical Communication Systems And Networks

COURSE OUTCOME: At the end of the course, the student will be able to understand the

CO1: Realize Basic Elements in Optical Fibers, Different Modes and Configurations.
CO2: Analyze The Transmission Characteristics Associated with Dispersion and Polarization Techniques.
CO3: Design Optical Sources and Detectors with Their Use in Optical Communication System.
CO4: Construct Network components and uses.
CO5: Design Optical Communication Systems And Its Networks.

UNIT-1	**INTRODUCTION TO OPTICAL FIBER COMMUNICATION**	**9 HOURS**

Introduction - The General Systems - Advantages of Optical Fiber Communication- Ray Theory Transmission : Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays - Electromagnetic Mode Theory for Optical Propagation: Modes in a Planar Guide, Phase and group velocity - Cylindrical Fiber: Step index fibers, Graded index fibers - Single mode fibers:

UNIT-2	**TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS**	**9 HOURS**

Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Mie Scattering -Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering – Fiber Bend Loss – Dispersion- Chromatic dispersion: Material dispersion, Waveguide dispersion- Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber.

UNIT-3	**OPTICAL SOURCES AND OPTICAL DETECTORS**	**9 HOURS**

The laser : Absorption and emission of radiation, Population inversion , Optical feedback and laser oscillation, Threshold condition for laser oscillation- Optical emission from semiconductors: The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Hetero junctions- LED: Introduction- Power and Efficiency - LED structures: Planar LED, Dome LED, Surface emitter LED, Edge emitter LED- LED Characteristics. Optical Detectors: Introduction, Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photodiode, P-I-N Photo Diode and Avalanche Photodiode.

UNIT-4	**WDM CONCEPTS AND COMPONENTS:**	**9 HOURS**

Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Optical amplifiers: Basic application and Types. Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Ampli:fiers, Wideband Optical Amplifiers

UNIT-5	**OPTICAL NETWORKS**	**9 HOURS**

Introduction- Optical Network Concepts: Optical Network topologies, Wavelength Division Multiplexed Networks, Public Telecommunications Network Overview- Optical Network Transmission Modes, Layers And Protocols: Synchronous Networks, Asynchronous Transfer Mode, Open System Interconnection Reference Model, Optical Transport Network, Internet Protocol- Wavelength Routing Networks: Routing And Wavelength Assignment- Optical Switching Networks: Optical Circuit Switched Networks, Optical Packet Switched Networks,

Multiprotocol Label Switching, Optical Burst Switching Networks.	
TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)	
1.	John M.Senior, “Optical Fiber Communication”, Pearson Education, Fouth Edition.2010.
2.	Gred Keiser,"Optical Fiber Communication”, McGraw Hill Education (India) Private Limited. FifthEdition, Reprint 2013.
REFERENCE BOOKS	
1.	Rajiv Ramaswami, Kumar N. Sivaranjan, "Optical Networks A practical perspective", 2nd edition, Elsevier, 2004
2.	Djafar K. Mynbaev, Lowell L. Scheiner, "Fiber-Optic Communications Technology", 1st edition, Pearson Education, 2001
3.	T5. J.Gowar, "Optical Communication System", 2nd edition, Prentice Hall of India, 2001

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECE027	**WIRELESS BROADBAND NETWORKS**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks
- To study the architecture and interference mitigation techniques in 3G standards
- To learn about 4G technologies and LTE-A in mobile cellular network.
- To learn about the layer level functionalities in interconnecting networks.
- To study the emerging techniques in 5G network.

COURSE OUTCOME: Upon completion of the course, the student will be able to

CO1: Design and implement the various protocols in wireless networks.
CO2: Analyze the architecture of 3G network standards.
CO3: Analyze the difference of LTE-A network design from 4G standard.
CO4: Design the interconnecting network functionalities by layer level functions.
CO5: Explore the current generation (5G) network architecture.

UNIT-1	**WIRELESS PROTOCOLS**	**9 HOURS**

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP

UNIT-2	**3G EVOLUTION**	**9 HOURS**

IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.		
UNIT-3	**4G EVOLUTION**	**9 HOURS**
Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure		
UNIT-4	**LAYER-LEVEL FUNCTIONS**	**9 HOURS**
Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimediabroadcast/multicast, location-based services		
UNIT-5	**5G EVOLUTION**	**9 HOURS**
5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008	
2.	Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008.	
REFERENCE BOOKS		
1.	Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011	
2.	Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014	
3.	Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015	

Course Code	Course Title	L	T	P	J	C
22ECE028	SOFTWARE DEFINED NETWORKS	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization.

COURSE OUTCOME: After the successful completion of this course, the student will be able to

CO1: Describe the motivation behind SDN and its data plane
CO2: Identify the functions of control plane
CO3: Apply SDN to networking applications
CO4: Apply various operations of network function virtualization
CO5: Explain various use cases of SDN

UNIT-1	SDN: BACKGROUND AND DATA PLANE	6 HOURS

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDNData Plane – Open Flow Logical Network Device – Open Flow Protocol

UNIT-2	SDN CONTROL PLANE	6 HOURS

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – Open Daylight – REST – Cooperation and Coordination among Controllers

UNIT-3	SDN ARCHITECTURE AND NETWORKING	6 HOURS

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- -Mobility and Wireless – Information-centric Networking

UNIT-4	NETWORK FUNCTION VIRTUALIZATION	6 HOURS

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV

UNIT-5	NETWORK VIRTUALIZATION	6 HOURS

Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – Open Daylight's Virtual Tenant Network – CoSoftware-Defined Infrastructure-software program to build a SDN based application

TOTAL LECTURE HOURS: 30 HOURS

PRACTICAL EXERCISES:

Installing Mininet simulator
Creating a 1 controller, 3 node topology, POX controller
Ability to view, read/write Flow table rules (for different applications - say firewall, Learningswitch etc.), POX, Open vSwitch
Building a SDN based application

TOTAL PRACTICAL HOURS: 30 HOURS
TOTAL HOURS: 60 HOURS

TEXT BOOK(S)

1.	William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud",Pearson Education, 1st Edition, 2015.
2.	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013

REFERENCE BOOKS

1.	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014
2.	Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
3.	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2ndEdition, O'Reilly Media, 2017

Course Code	Course Title	L	T	P	J	C
22ECE029	MASSIVE MIMO NETWORKS	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To gain knowledge about massive MIMO networks.
- To understand the massive MIMO propagation channels.
- To learn about channel estimation in single cell and multicell massive MIMO systems.
- To comprehend the concepts of massive MIMO deployment in the context of single cell andmulti cell deployment

COURSE OUTCOME:

CO1: Understand and explain massive MIMO networks.
CO2: Analyze massive MIMO propagation channels and their capacity bounds
CO3: Examine channel estimation techniques for single cell system.
CO4: Analyze channel estimation techniques for multi cell system.
CO5: Explain the concepts underlining the deployment of single and multicell massiveMIMO systems

UNIT-1	MASSIVE MIMO NETWORKS	6 HOURS

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

UNIT-2	**THE MASSIVE MIMO PROPAGATION CHANNEL**	**6 HOURS**
Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels		
UNIT-3	**SINGLE-CELL SYSTEMS**	**6 HOURS**
Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion-Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility		
UNIT-4	**MULTI-CELL SYSTEMS**	**6 HOURS**
Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-SynchronousPilot Interference		
UNIT-5	**CASE STUDIES**	**6 HOURS**
Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies		
TOTAL LECTURE HOURS: 30 HOURS		

PRACTICAL EXERCISES: **30 PERIODS**

Implementation of (Using Matlab)

1. Massive MIMO hybrid beamforming
2. Single cell massive MIMO downlink communications
3. Multicell massive MIMO downlink communications.
4. Precoding in massive MIMO single cell and multicell downlink communications
5. Channel estimation in massive MIMO system

TOTAL PRACTICALS HOURS: 30 HOURS

TEXT BOOK(S)

1.	Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017. (UNIT I)
2.	Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (UNITS II-V

REFERENCE BOOKS

1.	Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected

	Applications", Springer 2018
2.	Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3.	Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017

Course Code	Course Title	L	T	P	J	C
22ECE030	ADVANCED WIRELESS COMMUNICATION TECHNIQUES	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To understand the evolving paradigm of cooperative communication
- To understand concepts related to green wireless communication
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies

COURSE OUTCOME: At the end of the course, the student will be able to understand the

CO1: The student would be able to appreciate the necessity and the design aspects of cooperativecommunication

CO2: The student would be able to appreciate the necessity and the design aspects of greenwireless communication.

CO3: The student would be able to evolve new techniques in wireless communication

CO4: The students would be able to demonstrate the feasibility of using mathematical models usingsimulation tools.

CO5: The student would be able to demonstrate the impact of the green engineering solutions in aglobal, economic, environmental and societal context

UNIT-1	COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS	9 HOURS

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes

UNIT-2	COOPERATIVE TECHNIQUES	9 HOURS

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE Advanced.

UNIT-3	RELAY-BASED COOPERATIVE CELLULAR NETWORKS	9 HOURS
Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.		

UNIT-4	GREEN RADIO NETWORKS	9 HOURS
Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications		

UNIT-5	ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS	9 HOURS
Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relayingfor cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”,Cambridge University Press, 2011.
2.	Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Radio Communication Networks”, Cambridge University Press, 2012.

REFERENCE BOOKS

1.	F. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012
2.	Ramjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers,2010
3.	Jinsong Wu, Sundeep Rangan and Honggang Zhang, “Green Communications: TheoreticalFundamentals, Algorithms and Applications”, CRC Press, 2012

Course Code	Course Title	L	T	P	J	C
22ECE031	4G / 5G COMMUNICATION NETWORKS	2	0	2	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.

- To learn the security features in 5G networks.

COURSE OUTCOME:

CO1: To understand the evolution of wireless networks.
CO2: To learn the concepts of 5G networks.
CO3: To comprehend the 5G architecture and protocols.
CO4: To understand the dynamic spectrum management.
CO5: To learn the security aspects in 5G networks

UNIT-1	**EVOLUTION OF WIRELESS NETWORKS**	**6 HOURS**

Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G,Next Generation core(NG-core), visualized Evolved Packet core(vEPC).

UNIT-2	**5G CONCEPTS AND CHALLENGES**	**6 HOURS**

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-3	**NETWORK ARCHITECTURE AND THE PROCESSES**	**6 HOURS**

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE

UNIT-4	**DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES**	**6 HOURS**

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT-5	**SECURITY IN 5G NETWORKS**	**6 HOURS**

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

TOTAL LECTURE HOURS: 30 HOURS

PRACTICAL EXERCISES:

SIMULATION USING MATLAB

1. 5G-Compliant waveform generation and testing
2. Modeling of 5G Synchronization signal blocks and bursts
3. Channel modeling in 5G networks
4. Multiband OFDM demodulation
5. Perfect Channel estimation

Development of 5g New Radio Polar Coding

TOTAL PRACTICAL HOURS: 30 HOURS
TOTAL HOURS: 60 HOURS

TEXT BOOK(S)

1.	5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019

2.	An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020
REFERENCE BOOKS	
1.	5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen,CopyrightedMaterial.
2.	5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019

MANAGEMENT ELECTIVE (VII SEMESTER)

Course Code	Course Title	L	T	P	J	C
22EMT001	PRINCIPLES OF MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To sketch the Evolution of Management.
2. To extract the functions and principles of management.
3. To learn the application of the principles in an organization.
4. To study the various HR related activities.
5. To analyse the position of self and company goals towards business.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand managerial functions like planning, organizing, staffing, leading & controlling.
CO2. Have same basic knowledge on international aspect of management.
CO3. Ability to understand management concept of organizing.
CO4. Ability to understand management concept of directing.
CO5. Ability to understand management concept of controlling.

UNIT-1	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9 HOURS

Definition of Management — Science or Art — Manager Vs Entrepreneur- types of managers- managerial roles and skills — Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment — Current trends and issues in Management

UNIT-2	PLANNING	9 HOURS

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process

UNIT-3	ORGANISING	9 HOURS

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT-4	DIRECTING	9 HOURS

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT-5	CONTROLLING	9 HOURS
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998
2	Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
REFERENCE BOOKS:	
1	Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.
2	Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011
3	Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

Course Code	Course Title	L	T	P	J	C
22EMT002	TOTAL QUALITY MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. Explain the TQM Principles for application.
3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
5. Illustrate and apply QMS and EMS in any organization

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Ability to apply TQM concepts in a selected enterprise.

CO2. Ability to apply TQM principles in a selected enterprise.

CO3. Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4. Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5. Ability to apply QMS and EMS in any organization.

UNIT-1	INTRODUCTION	9 HOURS

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.		
UNIT-2	**TQM PRINCIPLES**	**9 HOURS**
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.		
UNIT-3	**TQM TOOLS & TECHNIQUES I**	**9 HOURS**
The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
UNIT-4	**TQM TOOLS & TECHNIQUES II**	**9 HOURS**
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.		
UNIT-5	**QUALITY MANAGEMENT SYSTEM**	**9 HOURS**
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		
	TOTAL HOURS:	**45 HOURS**
TEXT BOOK(S):		
1	Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre, Hemant Urdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.	
REFERENCE BOOKS:		
1	Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.	
2	Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth Heinemann Ltd, 2016.	
3	Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.	
4	Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.	

Course Code	Course Title	L	T	P	J	C
22EMT003	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. Understanding the concept of Engineering Economics.
2. Implement various micro economics concept in real life.
3. Gaining knowledge in the field of macro economics to enable the students to have better
4. understanding of various components of macro economics.
5. Understanding the different procedures of pricing.

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2. Evaluate the economic theories, cost concepts and pricing policies

CO3. Understand the market structures and integration concepts

CO4. Understand the measures of national income, the functions of banks and concepts of globalization

CO5. Apply the concepts of financial management for project appraisal

UNIT-1	DEMAND & SUPPLY ANALYSIS	9 HOURS

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis.Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity

UNIT-2	PRODUCTION AND COST ANALYSIS	9 HOURS

Production function - Returns to scale - Production optimization - Least cost input – Isoquants Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT-3	PRICING	9 HOURS

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT-4	FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)	9 HOURS

Balance sheet and related concepts - Profit & Loss Statement and related concepts - - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT-5	CAPITAL BUDGETING (ELEMENTARY TREATMENT)	9 HOURS

Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.	
TOTAL HOURS:	**45 HOURS**
TEXT BOOK(S):	
1	Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2	Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.
REFERENCE BOOKS:	
1	Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011
2	Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3	Zahid A khan: Engineering EconoDonald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
4	my, "Engineering Economy", Dorling Kindersley, 2012
5	Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

Course Code	Course Title	L	T	P	J	C
22EMT004	HUMAN RESOURCE MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To provide knowledge about management issues related to staffing,
2. To provide knowledge about management issues related to training,
3. To provide knowledge about management issues related to performance
4. To provide knowledge about management issues related to compensation
5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Students would have gained knowledge on the various aspects of HRM

CO2. Students will gain knowledge needed for success as a human resources professional.

CO3. Students will develop the skills needed for a successful HR manager.

CO4. Students would be prepared to implement the concepts learned in the workplace.

CO5. Students would be aware of the emerging concepts in the field of HRM

UNIT-1	INTRODUCTION TO HUMAN RESOURCE MANAGEMENT	9 HOURS

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.

UNIT-2	HUMAN RESOURCE PLANNING	9 HOURS

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.		
UNIT-3	**TRAINING AND EXECUTIVE DEVELOPMENT**	**9 HOURS**
Types of training and Executive development methods – purpose – benefits.		
UNIT-4	**EMPLOYEE COMPENSATION**	**9 HOURS**
Compensation plan — Reward — Motivation — Career Development - Mentor — Protege relationships		
UNIT-5	**PERFORMANCE EVALUATION AND CONTROL**	**9 HOURS**
Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):	
1	Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2	John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.
REFERENCE BOOKS:	
1	Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2	Dessler, "Human Resource Management", Pearson Education Limited, 2007.
3	Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.

Course Code	Course Title	L	T	P	J	C
22EMT005	KNOWLEDGE MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To understand the process of acquiry knowledge from experts
2. To understand the learning organization.
3. To use the knowledge management tools.
4. To develop knowledge management Applications.
5. To design and develop enterprise applications

COURSE OUTCOMES:

After the completion of this course, the students should be able to

CO1. Understand the process of acquiry knowledge from experts
CO2. Understand the learning organization.
CO3. Use the knowledge management tools.
CO4. Develop knowledge management Applications.
CO5. Design and develop enterprise applications

UNIT-1	INTRODUCTION	9 HOURS

The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT-2	CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING	9 HOURS

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT-3	KNOWLEDGE MANAGEMENT-THE TOOLS	9 HOURS

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information

UNIT-4	KNOWLEDGE MANAGEMENT APPLICATION	9 HOURS

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT-5	FUTURE TRENDS AND CASE STUDIES	9 HOURS

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

	TOTAL HOURS:	**45 HOURS**
TEXT BOOK(S):		
1	Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.	
REFERENCE BOOKS:		
1	Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.	

Course Code	Course Title	L	T	P	J	C
22EMT006	INDUSTRIAL MANAGEMENT	3	0	0	0	3
		Syllabus version			v. 1.1	

COURSE OBJECTIVES:

The course enables the learner to

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

COURSE OUTCOME:

After the completion of this course, the students should be able to

CO1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2. Discuss the planning; organizing and staffing functions of management in professional organization.

CO3. Apply the leading; controlling and decision making functions of management in professional organization.

CO4. Discuss the organizational theory in professional organization.

CO5. Apply principles of productivity and modern concepts in management in professional organization.

UNIT-1	INTRODUCTION	9 HOURS

Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union

UNIT-2	FUNCTIONS OF MANAGEMENT	9 HOURS
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety.		
UNIT-3	**ORGANIZATIONAL BEHAVIOUR**	**9 HOURS**
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches.		
UNIT-4	**GROUP DYNAMICS**	**9 HOURS**
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics.		
UNIT-5	**MODERN CONCEPTS**	**9 HOURS**
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re- engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage		
	TOTAL HOURS:	**45 HOURS**

TEXT BOOK(S):

1.	M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, NewDelhi, 2009.
2.	Koontz. H. and Weihrich. H., “Essentials of Management: An International Perspective”, 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCE BOOKS:

1	Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, sixth 2008

MANDATORY COURSE I (NON CREDIT COURSE)

Course Code	Course Title	L	T	P	J	C
22MCT001	INTRODUCTION TO WOMEN AND GENDER STUDIES	3	0	0	0	0
		Syllabus version	v. 1.0			

COURSE OBJECTIVES: After studying this course, you should be able to:

To study in detail about the introduction to women and gender studies.

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Will be able to understand the concept of the woman and gender studies.
2.Have in-depth knowledge of feminist theory.
3.Able to understand the women's motivation.
4.Able to know about the gender and language.
5.Able to know about the gender and representation.

UNIT-I	CONCEPTS	9 HOURS

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT-II	FEMINIST THEORY	9 HOURS

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT-III	WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL	9 HOURS

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT-IV	GENDER AND LANGUAGE	9 HOURS

Linguistic Forms and Gender. Gender and narratives.

UNIT-V	GENDER AND REPRESENTATION	9 HOURS

Advertising and popular visual media.

TOTAL LECTURE HOURS:	45 HOURS

Course Code	Course Title	L	T	P	J	C
22MCT002	ELEMENTS OF LITERATURE	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

COURSE OUTCOMES: After completion of this course, the students should be able to

Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

UNIT-I	COURSE CONTENTS	9 HOURS

Introduction to Elements of Literature
1. Relevance of literature

a) Enhances Reading, thinking, discussing and writing skills.
b) Develops finer sensibility for better human relationship.
c) Increases understanding of the problem of humanity without bias.
d) Providing space to reconcile and get a cathartic effect.
2. Elements of fiction
a) Fiction, fact and literary truth.
b) Fictional modes and patterns.
c) Plot character and perspective.
3. Elements of poetry
a) Emotions and imaginations.
b) Figurative language.
c) (Simile, metaphor, conceit, symbol, pun and irony).
d) Personification and animation. e) Rhetoric and trend.

UNIT-II	ELEMENTS OF DRAMA	9 HOURS

Elements of drama a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.

UNIT-III	READINGS:	9 HOURS

1.1 Textbook:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

1.2 *Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

UNIT-IV	OTHER SESSION:	9 HOURS

4.1*Tutorials:
4.2*Laboratory:
4.3*Project: The students will write a term paper to show their understanding of a particular piece of literature

UNIT-V	ASSESSMENT:	9 HOURS

5.1 HA:
5.2 Quizzes-HA:
5.3 Periodical Examination: one
5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
5.5 Final Exam:

TOTAL LECTURE HOURS:	45 HOURS

Course Code	Course Title	L	T	P	J	C
22MCT003	FILM APPRECIATION	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century.

COURSE OUTCOMES: After completion of this course, the students should be able to

The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

UNIT-I	Theme - A: The Component of Films	9 HOURS

A-1: The material and equipment
A-2: The story, screenplay and script
A-3: The actors, crew members, and the director
A-4: The process of film making… structure of a film

UNIT-II	Theme - B: Evolution of Film Language	9 HOURS

B-1: Film language, form, movement etc.
B-2: Early cinema… silent film (Particularly French)
B-3: The emergence of feature films: Birth of a Nation
B-4: Talkies

UNIT-III	Theme - C: Film Theories and Criticism/Appreciation	9 HOURS

C-1: Realist theory; Auteurists
C-2: Psychoanalytic, Ideological, Feminists
C-3: How to read films?
C-4: Film Criticism / Appreciation

UNIT-IV	Theme – D: Development of Films	9 HOURS

D-1: Representative Soviet films
D-2: Representative Japanese films
D-3: Representative Italian films
D-4: Representative Hollywood film and the studio system

UNIT-V	Theme - E: Indian Films	9 HOURS

E-1: The early era
E-2: The important films made by the directors
E-3: The regional films
E-4: The documentaries in India

TOTAL LECTURE HOURS:	45 HOURS

Course Code	Course Title	L	T	P	J	C
22MCT004	WELL BEING WITH TRADITIONAL PRACTICES (YOGA,AYURVEDA AND SIDDHA)	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To enjoy life happily with fun filled new style activities that help to maintain health also
2.To adapt a few lifestyle changes that will prevent many health disorders
3.To be cool and handbill every emotion very smoothly in every walk of life
4.To learn to eat cost effective but healthy foods that are rich in essential nutrients
5.To develop immunity naturally that will improve resistance against many health disorders

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Learn the importance of different components of health
2.Gain confidence to lead a healthy life
3.Learn new techniques to prevent lifestyle health disorders
4.Understand the importance of diet and workouts in maintaining health
5. Learn new techniques of yoga.

UNIT-I	HEALTH AND ITS IMPORTANCE	9 HOURS

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT-II	DIET	9 HOURS

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

UNIT-III	ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH	9 HOURS

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT-IV	**MENTAL WELLNESS**	**9 HOURS**

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

UNIT-V	**YOGA**	**9 HOURS**

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):

1.	Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2.	Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCE BOOKS:

1.	WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D.Roberts
2.	A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

Course Code	Course Title	L	T	P	J	C
22MCT005	INDIAN CONSTITUTION	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

In this course on Indian Constitution, the students will be known about the Indian constitution and government structures and government systems.

COURSE OUTCOMES: After completion of this course, the students should be able to

CO1: Understand the functions of the Indian government
CO2: Understand and abide the rules of the Indian constitution
CO3: Understand and appreciate different government structures.
CO3: Understand and appreciate different structures and courts.
CO3: Understand the functions of government systems.

UNIT-I	INTRODUCTION	09 HOURS

Historical Background – Constituent Assembly of India – Philosophical Foundations Of The Indian Constitution – Preamble.

UNIT-II	INDIAN CONSTITUTION	09 HOURS

Fundamental Rights – Directive Principles Of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies For Citizens.

UNIT-III	GOVERNMENT STRUCTURES	09 HOURS

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister.

UNIT-IV	STRUCTURES AND COURTS	09 HOURS

Cabinet – Parliament – Supreme Court of India – Judicial Review-High Courts and other Subordinate Courts.

UNIT-V	GOVERNMENT SYSTEMS	09 HOURS

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States.

TOTAL LECTURE HOURS:	45 HOURS

TEXT BOOK(S):

1. Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.

REFERENCE BOOKS:

1. Sharma, Brij Kishore, “Introduction to the Constitution of India”, Prentice Hall of India, New Delhi.

Course Code	Course Title	L	T	P	J	C
22MCT006	INDUSTRIAL SAFETY	3	0	0	0	0
		Syllabus version				v. 1.0

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To Understand the Introduction and basic Terminologies safety.
2.To enable the students to learn about the Important Statutory Regulations and standards.
3.To enable students to Conduct and participate the various Safety activities in the Industry.
4.To have knowledge about Workplace Exposures and Hazards.
5.To assess the various Hazards and consequences through various Risk Assessment Techniques.

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Understand the basic concept of safety.
2.Obtain knowledge of Statutory Regulations and standards.
3.Know about the safety Activities of the Working Place.
4.Analyze on the impact of Occupational Exposures and their Remedies
5.Obtain knowledge of Risk Assessment Techniques.

UNIT-I	SAFETY TERMINOLOGIES	9 HOURS

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT-II	STANDARDS AND REGULATIONS	9 HOURS

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998-Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT-III	SAFETY ACTIVITIES	9 HOURS

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT-IV	WORKPLACE HEALTH AND SAFETY	9 HOURS

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release

UNIT-V	HAZARD IDENTIFICATION TECHNIQUES	9 HOURS

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL LECTURE HOURS:	45 HOURS

TEXT BOOK(S):	
1.	R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2.	L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
REFERENCE BOOKS:	
1.	Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.
2.	Alan Waring.(1996).Safety management system: Chapman &Hall,England
3.	Society of Safety Engineers, USA

MANDATORY COURSE II (NON CREDIT COURSE)

Course Code	Course Title	L	T	P	J	C
22MCT007	ETHICS AND VALUES	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2.To understand the negative health impacts of certain unhealthy behaviors
3.To appreciate the need and importance of physical, emotional health and social health

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Follow sound morals and ethical values scrupulously to prove as good citizens
2.Understand various social problems and learn to act ethically
3.Understand the concept of addiction and how it will affect the physical and mental health
4.Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
5.Identify the main typologies, characteristics, activities, actors and forms of cybercrime

UNIT-I	BEING GOOD AND RESPONSIBLE	9 HOURS

Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

UNIT-II	ADDICTION AND HEALTH	9 HOURS

Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

UNIT-III	DRUG ABUSE AND TECHNOLOGIES	9 HOURS

Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites

UNIT-IV	SOCIAL ISSUES 2	9 HOURS

Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices; White collar crimes - Tax evasions – Unfair trade practices		
UNIT-V	**PERSONAL AND PROFESSIONAL ETHICS**	**9 HOURS**
Dishonesty - Stealing - Malpractices in Examinations – Plagiarism		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S):		
1.	Dhaliwal, K.K (2016), "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts, Writers Choice, New Delhi, India.	
2.	Vittal, N (2012), "Ending Corruption? - How to Clean up India?", Penguin Publishers, UK.	
REFERENCE BOOKS:		
1.	Pandey, P. K (2012), "Sexual Harassment and Law in India", Lambert Publishers, Germany.	
2.	Pagliaro, L.A. and Pagliaro, A.M (2012), "Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations", Wiley Publishers, U.S.A.	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22MCT008	**HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA**	**3**	**0**	**0**	**0**	**0**
		Syllabus version			**v. 1.0**	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To understand the concepts and perspectives in India.
2.To understand the historiography of science in India.
3.To understand the science and technology in ancient, Medieval and colonial India

COURSE OUTCOMES: After completion of this course, the students should be able to

1. Understand various concepts and perspective history of science in India.
2.Understand historiography of science and technology in India
3. Understand the science and technology in ancient India.
4. Understand the science and technology in medieval India.
5. Understand the science and technology in colonial India.

UNIT-I	**CONCEPTS AND PERSPECTIVES**	**9 HOURS**
Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.		
UNIT-II	**HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA**	**9 HOURS**
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.		
UNIT-III	**SCIENCE AND TECHNOLOGY IN ANCIENT INDIA**	**9 HOURS**

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.		
UNIT-IV	**SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA**	**9 HOURS**
Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest		
UNIT-V	**SCIENCE AND TECHNOLOGY IN COLONIAL INDIA**	**9 HOURS**
Science and the Empire Indian response to Western Science Growth of techno-scientific institutions		
	TOTAL LECTURE HOURS:	**45 HOURS**

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22MCT009	**POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY**	**3**	**0**	**0**	**0**	**0**
		Syllabus version			**v. 1.0**	
COURSE OBJECTIVES: After studying this course, you should be able to:						
This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.						
COURSE OUTCOMES: After completion of this course, the students should be able to						
The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.						
UNIT-I	**INTRODUCTION**					**9 HOURS**
Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.						
UNIT-II	**CAPITALISM**					**9 HOURS**
Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. Fascism and totalitarianism. World war I and II and cold war.						
UNIT-III	**COMMUNISM**					**9 HOURS**
Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.						
UNIT-IV	**WELFARE STATE**					**9 HOURS**
Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures) Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature.						
UNIT-V	**CICILIZATION**					**9 HOURS**
Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society. Future directions.						
	TOTAL LECTURE HOURS:					**45 HOURS**

Course Code	Course Title	L	T	P	J	C
22MCT010	STATE, NATION BUILDING AND POLITICS IN INDIA	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System.

COURSE OUTCOMES: After completion of this course, the students should be able to

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

UNIT-I	INTRODUCTION	9 HOURS

Understanding the need and role of State and politics. Introduction to the state, nation building and politics in India.

UNIT-II	ORGANS OF STATE	9 HOURS

Development of Nation-State, sovereignty, sovereignty in a globalized world.
Organs of State – Executive, Legislature, Judiciary.

UNIT-III	NATION BUILDING IN INDIA	9 HOURS

Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India. 1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT-IV	FEDERAL SYSTEM	9 HOURS

Constitution making and the Constitution of India. Goals, objective and philosophy. Why a federal system? National integration and nation-building.

UNIT-V	POLITICS IN INDIA	9 HOURS

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?

TOTAL LECTURE HOURS:	45 HOURS

Course Code	Course Title	L	T	P	J	C
22MCT011	DISASTER MANAGEMENT	3	0	0	0	0
		Syllabus version			v. 1.0	

COURSE OBJECTIVES: After studying this course, you should be able to:

1.To provide students an exposure to disasters, their significance and types.
2.To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
3.To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4.To enhance awareness of institutional processes in the country and
5.To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

COURSE OUTCOMES: After completion of this course, the students should be able to

1.Differentiate the types of disasters, causes and their impact on environment and society
2.Assess vulnerability and various methods of risk reduction measures as well as mitigation.
3.Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
4.Know about the disaster risk management in India.
5.understand the applications and case studies and of works of disaster management.

UNIT-I	INTRODUCTION TO DISASTERS	9 HOURS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT-II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9 HOURS

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT-III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9 HOURS

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-IV	DISASTER RISK MANAGEMENT IN INDIA	9 HOURS

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes 106

and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment		
UNIT-V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9 HOURS**
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S):	
1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423
2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
REFERENCE BOOKS:	
1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2.	Government of India, National Disaster Management Policy,2009.

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories)

(Open Electives offered by Department of Electronics and Communication Engineering)

OPEN ELECTIVE I

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22ECO001	Arduino for Engineers	3	0	0	0	3	3
2	22ECO002	Introduction to Embedded system	3	0	0	0	3	3
3	22ECO003	Optoelectronics	3	0	0	0	3	3
4	22ECO004	Telecommunication Network Management	3	0	0	0	3	3

OPEN ELECTIVE II

S.No	Course Code	Course Name	L	T	P	J	Contact Hours	Credits
1	22ECO005	VLSI for Wireless Communication	3	0	0	0	3	3
2	22ECO006	Consumer Electronics	3	0	0	0	3	3
3	22ECO007	Design For Testability	3	0	0	0	3	3
4	22ECO008	Introduction to Control Systems	3	0	0	0	3	3

Open Elective-I

Course Code	Course Title	L	T	P	J	C
22ECO001	ARDUINO FOR ENGINEERS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Understanding of Arduino microcontroller architecture and programming,
2. Interfacing of Arduino board with various I/O devices.
3. Serial data transmission using Arduino board.
4. Learning of ARM processor Instruction set and programming concepts.

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Understand of features of Arduino board.
2. Analyze of internal Architecture of Arduino board.
3. Apply Arduino board programming concepts.
4. Design and implement Buggy project based on different goals and challenges defined.

UNIT-1	Arduino Microcontroller	9 HOURS

Features of Arduino Microcontroller, Architecture of Arduino, Different boards of Arduino, Arduino Interfacing and Applications.

UNIT-2	Arduino Microcontroller Features	9 HOURS

Anatomy of an Interactive Device like Sensors and Actuators, A to D converters and their comparison, Blinking an LED, LCD Display, Driving a DC and stepper motor, Temperature sensors, Serial Communications, Sending Debug Information from Arduino to Your Computer, Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino, Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino. Light controlling with PWM.

UNIT-3	Programming of Arduino	9 HOURS

The Code designing step by step. Taking a Variety of Actions Based on a Single Variable, Comparing Character and Numeric Values, Comparing Strings, Performing Logical Comparisons, Performing Bitwise Operations, Combining Operations and Assignment, Using Embedded techniques to program Arduino microcontroller, Understanding the libraries of Arduino programming language and applying for circuit design

UNIT-4	Introduction to ARM processor	9 HOURS

Features of ARM processor, ARM Architecture, Instruction set, ARM Programming		
UNIT-5	**Arduino based projects**	**9 HOURS**
Introduction to Arduino board. Programming examples of Arduino board. Interfacing of LED, seven segment display, ADC and DAC with Arduino board. Introduction to ARM processor kit.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Michael Mc Roberts, Beginning Arduino, Technology in action publications, Second Edition.	
2.	Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011)	
REFERENCE BOOKS		
1.	John Boxall, Arduino Workshop - A Hands-On Introduction with 65 Projects, No Starch Press; 1 edition (2013)	

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECO002	**INTRODUCTION TO EMBEDDED SYSTEMS**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To introduce the Building Blocks of Embedded System.
2. To Introduce Bus Communication in processors, Input/output interfacing.
3. To Educate in Various Embedded Development Strategies.
4. To impart knowledge in various real time operating systems.
5. To introduce Basics of Real time operating system and example tutorials to discuss on one real-time operating system tool.

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Explain fundamental embedded systems design paradigms, architectures, and peripherals.
2. Describe the hardware architecture and features of embedded networking peripherals.
3. Develop a model of an embedded system.
4. Describe the concepts of real time operating systems.
5. Develop programming skills in embedded systems for various applications.

UNIT-1	**INTRODUCTION TO EMBEDDED SYSTEMS**	**9 HOURS**
Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		
UNIT-2	**EMBEDDED NETWORKING**	**9 HOURS**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.		
UNIT-3	**EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT**	**9 HOURS**
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.		
UNIT-4	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9 HOURS**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, ЧC/OS-II, RT Linux.		
UNIT-5	**EMBEDDED SYSTEM APPLICATION DEVELOPMENT**	**9 HOURS**
Case Study of Washing Machine- Automotive Application- Smart card System Application.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
	Peckol, "Embedded system Design", John Wiley & Sons,2010
2.	Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013

REFERENCE BOOKS

1.	Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
2.	Elicia White," Making Embedded Systems", O' Reilly Series, SPD,2011.
3.	Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006
4	Han-Way Huang," Embedded system Design Using C8051", Cengage Learning,2009.
5	Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

Course Code	Course Title	L	T	P	J	C
22ECO003	Optoelectronics	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To review basic semiconductor theory
2. To introduce the concepts of LED
3. To teach the principle of stimulated emission and devices based on it
4. To equip the student with the knowledge of Photovoltaics and display devices
5. To introduce the knowledge of optolectronic modulators

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Understand various kinds of semiconductor materials used in optoelectronics
2. Understand the mechanisms of light absorption and emission in p-n junctions
3. Use photodiodes, LEDs, and laser diodes for various applications.

UNIT-1	SEMICONDUCTOR THEORY	9 HOURS

Basic quantum mechanics, semiconductor statistics, carrier transport, optical processes, and junction theory, Properties of simple and compound semiconductors, Optical absorption, Optical recombination, Recombination and carrier lifetime

UNIT-2	LIGHT EMITTING DIODES	9 HOURS

Energy Bands. Direct and Indirect Bandgap Semiconductors: E-k Diagrams. pn Junction Principles. The pn Junction Band Diagram. Light Emitting Diodes. LED Materials. Heterojunction High Intensity LEDs. LED Characteristics. LEDs for Optical Fiber Communications, White LED for display and lighting applications.

UNIT-3	STIMULATED EMISSION DEVICES	9 HOURS

Stimulated Emission and Photon Amplification. Stimulated Emission Rate and Einstein Coefficients. Optical Fiber Amplifiers. LASER Oscillation Conditions. Principle of the Laser Diode. Heterostructure Laser Diodes. Rate Equation- Characteristics. Light Emitters for Optical Fiber Communications. Quantum Well and Quantum dot Devices. Vertical Cavity Surface Emitting Lasers (VCSELs). Optical Laser Amplifiers.

UNIT-4	PHOTOVOLTAICS AND DISPLAY DEVICES	9 HOURS

Photovoltaic Device Principles. pn Junction Photovoltaic I-V Characteristics. Solar Cells Materials, Devices and Efficiencies. Liquid crystal displays, Reflective and Trans reflective types, TFT displays, Plasma displays, LED TV

UNIT-5	POLARIZATION AND MODULATION OF LIGHT	9 HOURS

Polarization. Light Propagation in an Anisotropic Medium: Birefringence. Electro-Optic Effects.Acousto-Optic Modulator. Magneto-Optic Effects. Integrated Optical Modulators Electroabsorption modulators.Non-Linear Optics and Second Harmonic Generation.	
TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)	
1.	S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices", Pearson, 2013.
2.	Michael Parker, "Physics of optoelectronics", CRC press, 2018.
REFERENCE BOOKS	
1.	P. N. Prasad, "Nanophotonics", John Wiley & Sons, 200434. J. Singh, "Electronic and Optoelectronic Properties of Semiconductor Structures Cambridge university press, 2007.
2.	Deng-Ke Yang , Shin Tson Wu, "Fundamentals of Liquid Crystal Devices", Revised edition, John Wiley and sons, 2015.
3.	Saleh and Teich, "Fundamentals of Photonics", Wiley Interscience, 2 nd Edition, 2013.

Course Code	**Course Title**	**L**	**T**	**P**	**J**	**C**
22ECO004	**TELECOMMUNICATION NETWORK MANAGEMENT**	**3**	**0**	**0**	**0**	**3**
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To understand the concept of network management standards.
2. To design the common management information service element model.
3. To understand the various concept of information modelling.
4. To analyze the concept of SNMPv1 and SNMPv2 protocol.
5. To analyze the concept of examples of network management.

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Design and analyze of fault management.
2. Analyze the common management information protocol specifications.
3. Design and analyze of management information model.
4. Design the simple network management protocol.
5. Design the various types of network management tools.

UNIT-1	**FOUNDATIONS**	**9 HOURS**

Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros– functional model. Network management application functional requirements: Configuration

management– fault management– performance management–Error correlation technology– security management–accounting management– common management– report management– polity based management–service level management–management service–community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.		
UNIT-2	**COMMON MANAGEMENT INFORMATION SERVICE ELEMENT**	**9 HOURS**
CMISE model–service definitions–errors–scooping and filtering features– synchronization– functional units– association services– common management information protocol specification.		
UNIT-3	**INFORMATION MODELING FOR TMN**	**9 HOURS**
Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base		
UNIT-4	**SIMPLE NETWORK MANAGEMENT PROTOCOL**	**9 HOURS**
SNMPv1: managed networks–SNMP models– organization model–information model– SNMPv2 communication model–functional model–major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture– applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.		
UNIT-5	**NETWORK MANAGEMENT EXAMPLES**	**9 HOURS**
ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system– management platform case studies: OPENVIEW– ALMAP.		
	TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)		
1.	Mani Subramanian, “Network Management: Principles and Practice” Pearson Education, Second edition, 2010	
2.	Lakshmi G Raman, “Fundamentals of Telecommunications Network Management” ,Wiley, 1999	
REFERENCE BOOKS		
1.	Henry Haojin Wang, “Telecommunication Network Management”, Mc- Graw Hill ,1999	
2.	Salah Aidarous & Thomas Plevyak, “Telecommunication Network Management: Technologies and Implementations” , Wiley,1997	

OPEN ELECTIVE II

Course Code	Course Title	L	T	P	J	C
22ECO005	VLSI FOR WIRELESS COMMUNICATION	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To cover the design of VLSI circuits used in modern wireless transceivers.
2. To illustrate the design trade-offs in the transceivers with practical, real life circuit examples, with low power as an important design objective.
3. To discuss the architectures of wireless transceivers at the transistor level, using submicron CMOS.
4. To discuss the circuits such as low noise amplifiers, mixers, power amplifiers, oscillators, phase locked loops and A/D and D/A converters.

COURSE OUTCOME:

1. Ability to design wireless transceivers using low noise amplifiers.
2. Ability to design wireless transceivers using mixers, power amplifiers.
3. Ability to design wireless transceivers using oscillators, phase locked loops, A/D and D/A converters and frequency synthesizers.

UNIT-1	COMMUNICATION CONCEPTS	9 HOURS

Wireless systems, Standards, Access methods, Modulation schemes, Classical channel, Wireless Channel Description, Path Loss, Multipath Fading, Channel Model and Envelope Fading, Frequency Selective and Fast Fading.

UNIT-2	TRANSMITTER AND RECEIVER ARCHITECTURES	9 HOURS

Transmitter backend, Quadrature LO generator, Receiver Front End:, Filter Design, Rest of Receiver Front End, Derivation of NF, IIP3 of Receiver Front End - Wideband LNA Design, Narrow Band LNA:, Impedance Matching, Core Amplifier.

UNIT-3	ACTIVE AND PASSIVE MIXER	9 HOURS

Active Mixer: Balancing, Qualitative Description of the Gilbert Mixer, Distortion, Low Frequency Case: Analysis of Gilbert Mixer, Distortion, High Frequency Case, Noise.
Passive Mixer: Switching Mixer, Distortion in Unbalanced Switching Mixer, Conversion Gain in Unbalanced Switching Mixer, Noise in Unbalanced Switching Mixer, practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain in Single-Ended Sampling Mixer.

UNIT-4	ANALOG-TO-DIGITAL CONVERTERS	9 HOURS

Demodulators, A/D converters Used in a Receiver, Low-Pass Sigma-Delta Modulators, Implementation of Low-Pass Sigma-Delta Modulators, Bandpass Sigma-Delta Modulators, Implementation of Bandpass Sigma-Delta Modulators.

UNIT-5	FREQUENCY SYNTHESIZER	9 HOURS

PLL based frequency synthesizer, Phase detector/Charge pump, VCO, Dividers, Ring oscillators, Loop filter – General description, Design approaches.	
TOTAL LECTURE HOURS:	**45 HOURS**
TEXT BOOK(S)	
1.	Bosco Leung, "VLSI for Wireless Communication, Second Edition, Springer,2011.
2.	Emad N Farag, M.I Elmasry, “Mixed Signal VLSI Wireless Design Circuits and Systems”, Kluwer Publications, 2000.
REFERENCE BOOKS	
1.	David Tsee, Pramod Viswanath,” Fundamentals of Wireless Communication”, Cambridge Univ Press.

Course Code	Course Title	L	T	P	J	C
22ECO006	CONSUMER ELECTRONICS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. Troubleshoot different types of microphones and speakers.
2. Maintain audio systems.
3. Analyse the composite video signal used in TV signal transmission.
4. Troubleshoot colour TV receivers.
5. Maintain various consumer electronic appliances

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Understand the working of Audio System
2. Be familiar with the Television Systems
3. Troubleshoot a variety of Video Recording Systems
4. Implement an Embedded system based product
5. Study of office/ Home appliances.

UNIT-1	**AUDIO SYSTEM**	**9 HOURS**
Construction, working principles and applications of - Microphones, Loud Speaker, Digital sound recording system, Hi-Fi system		
UNIT-2	**VIDEO RECORDERS**	**9 HOURS**
Working principles of HDMI Home Theatre system, DVD, Digital Video Camera and CCTV Applications		
UNIT-3	**TELEVISION**	**9 HOURS**
Construction and working principles of Monochrome TV, Colour TV, working of cable TV and DTH, cable TV using internet		

UNIT-4	EMBEDDED APPLICATIONS	9 HOURS
Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller - Alarm Clock - Audio player - Software modem - Digital still camera - Telephone answering machine - Engine control unit		
UNIT-5	**OFFICE/ HOME APPLICATIONS**	**9 HOURS**
FAX and Photocopier - Microwave Oven: types, single chip controllers, wiring and safety instructions, technical specifications - Washing Machine: wiring diagram, electronic controller for washing machine, technical specifications, types of washing machine - Air conditioner and Refrigerators: Components features, applications, and technical specification.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	R.R Gulati, “Complete Satellite & cable Television”, New age International Publisher, 2nd edition Reprint, 2005
2.	Douglas V. Hall, “Microprocessor and Interfacing: Programming and Hardware”, Glencoe, 2nd edition, 2006
3	Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCE BOOKS

1.	A.K. Maini, “Colour Television & Video Technology”, CSB Publishers, 1994.
2.	Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc Graw Hill, 2004.
3.	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., “Industrial Robotics”, Mc Graw-Hill Singapore, 1996.

Course Code	Course Title	L	T	P	J	C
22ECO007	DESIGN FOR TESTABILITY	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

1. To describe the various fault models and to understand fault detection.
2. To understand the difficulties of combinational and sequential circuits under test.
3. To understand the principles of automatic test pattern generation and testable circuit design.
4. To understand the built in self-test and boundary scan standard.
5. To understand the testability techniques for system-on-a-chip design

COURSE OUTCOME:

1. Design and simulate the fault models.
2. Apply fault simulation algorithms for circuit under test.

3. Design test pattern generation circuits for combinational and sequential circuits.
4. Design built-in-self test for circuit under test.
5. Analyze the testability techniques for Embedded core design.

UNIT-1	INTRODUCTION TO TESTING	9 HOURS

Importance of testing - Testing during the VLSI life cycle - Challenges and levels of abstraction in VLSI testing - VLSI Technology Trends Affecting Testing -Types of testing. Fault Models - Defects, errors, Faults -Stuck-At Faults - Fault Equivalence, Fault Collapsing, Fault Dominance- Transistor Faults, Open and Short Faults, Delay Faults, Pattern Sensitivity and Coupling Faults - Analog Fault Models- Automatic test Equipment.

UNIT-2	LOGIC AND FAULT SIMULATION	9 HOURS

SCOAP Testability Analysis - Algorithms for True Value simulation - Compiled-Code Simulation, Event-Driven Simulation - Algorithms for Fault Simulation - Serial Fault Simulation, Parallel Fault Simulation, Deductive Fault Simulation, Concurrent Fault Simulation, Roth's TEST-DETECT Algorithm, Differential Fault Simulation.

UNIT-3	ATPG FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS	9 HOURS

Combinational Circuit: Algorithms and Representations, Redundancy Identification (RID), Combinational ATPG Algorithms - D-Calculus and D-Algorithm, PODEM and FAN. Sequential Circuit: ATPG for Single-Clock Synchronous Circuits, Time-Frame Expansion Method, Simulation-Based Sequential Circuit ATPG -CONTEST Algorithm, Genetic Algorithm.

UNIT-4	DFT METHODS AND BUILT-IN SELF-TEST	9 HOURS

DFT Methods - Ad Hoc Approach, Structured Approach - Scan Cell Designs - Scan Architectures - Scan Design Rules - Scan Design Flow. BIST - Design Rules - Test Pattern Generation - Output Response Analysis - Logic BIST Architectures - Fault Coverage Enhancement - BIST Timing Control - Logic BIST System Design - A Design Practice - Memory BIST.

UNIT-5	BOUNDARY SCAN STANDARD AND CORE-BASED TESTING	9 HOURS

Core-Based Design and Test Considerations - Digital Boundary Scan - IEEE Std. 1149.1 - Test Architecture and Operations, Test Access Port and Bus Protocols, Data Registers and BoundaryScan Cells, TAP Controller - Embedded Core Test Standard (IEEE Std. 1500) - Architecture, Wrapper Components and Functions - Comparisons between 1500 and 1149.1 Standards.

TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)

1.	M.L. Bushnell, V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits - Kluwer Academic Publishers, Reprint 2013.
2.	L.T. Wang, C.W. Wu and X. Wen, VLSI Test Principles and Architectures, Elsevier, 2006.
3.	Samiha Mourad, Yervant Zorian, "Principles of Testing Electronic Systems", A Wiley Interscience Publications, 2002.

REFERENCE BOOKS

1.	Alexander Miczo, “Digital Logic Testing and Simulation”, Second Edition, A John Wiley & Sons Inc. Publication, 2003.
2.	Alfred Crouch, “Design for test for digital IC & Embedded Core Systems”, Prentice Hall, 2002.

Course Code	Course Title	L	T	P	J	C
22ECO008	INTRODUCTION TO CONTROL SYSTEMS	3	0	0	0	3
		Syllabus version			v. 1.0	

COURSE OBJECTIVES:

After studying this course, you should be able to:

1. To impart knowledge on various representations of systems.
2. To familiarize time response analysis of LTI systems and steady state error.
3. To analyze the frequency responses and stability of the systems.
4. To analyze the stability of linear systems in frequency domain and time domain.
5. To develop linear models mainly state variable model and transfer function model.

COURSE OUTCOME:

After completion of this course, the students should be able to:

1. Design the basic mathematical model of physical System.
2. Analyze the time response analysis and techniques.
3. Analyze the transfer function from different plots
4. Apply the stability concept in various criterion.
5. Assess the state models for linear and continuous Systems.

UNIT-1	MATHEMATICAL MODELS OF PHYSICALSYSTEMS	9 HOURS

Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT-2	TIME RESPONSE ANALYSIS & ROOTLOCUSTECHNIQUE	9 HOURS

Standard test signals – Steady state error & error constants – Time Response of I and II order system–Root locus–Rules for sketching root loci.

UNIT-3	FREQUENCY RESPONSE ANALYSIS	9 HOURS

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT-4	STABILITY CONCEPTS & ANALYSIS	9 HOURS

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion – Stability from Bode plot – Relative stability from Nyquist & Bode – Closed loop frequency response.

UNIT-5	**STATE VARIABLE ANALYSIS**	**9 HOURS**
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.		
	TOTAL LECTURE HOURS:	**45 HOURS**

TEXT BOOK(S)	
1.	Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back McGraw Hill Education, 2018..
2.	Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015
3.	J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.
REFERENCE BOOKS	
1.	Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2.	Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.
3.	John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4.	S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5.	Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First Impression2010.